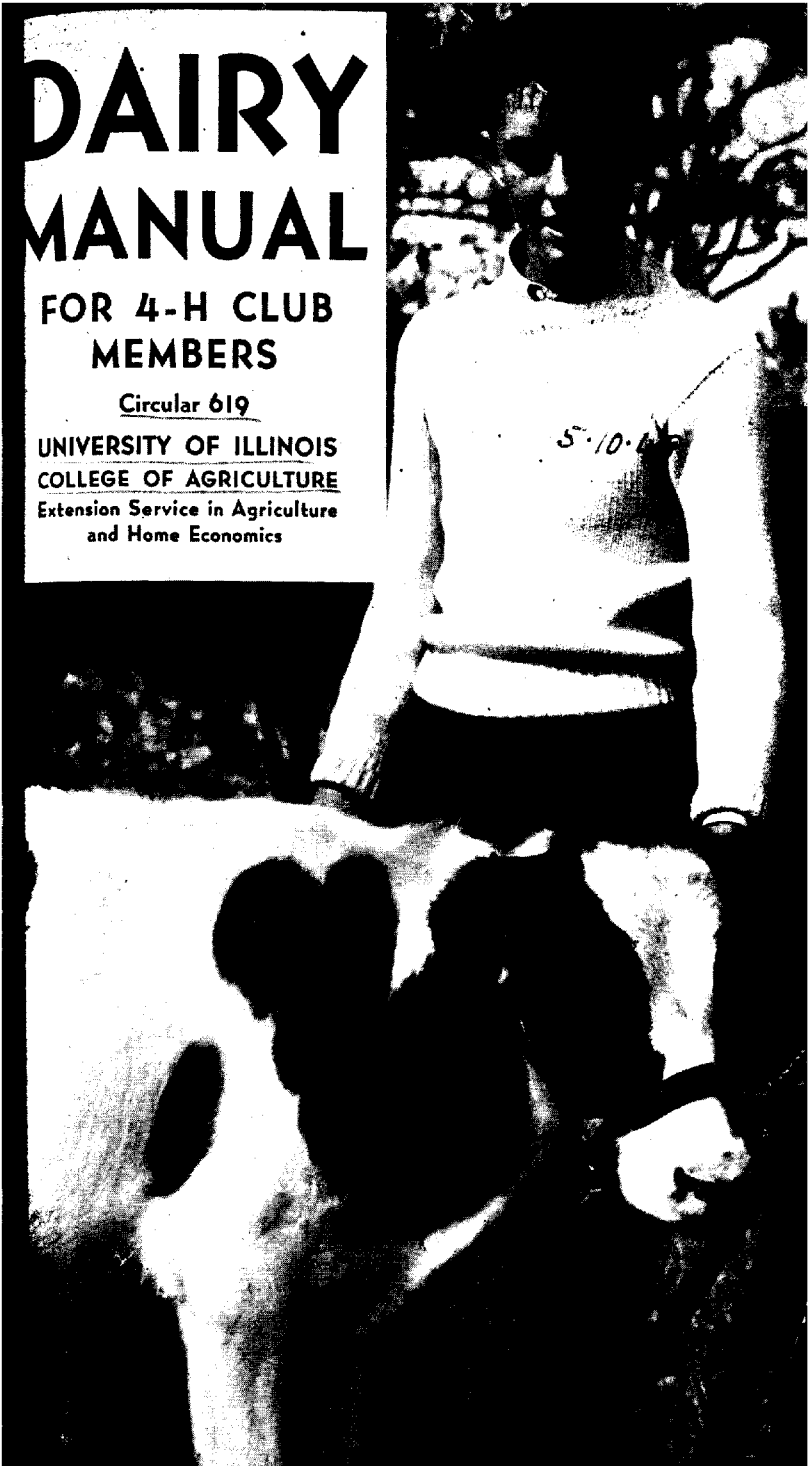


DAIRY MANUAL

FOR 4-H CLUB
MEMBERS

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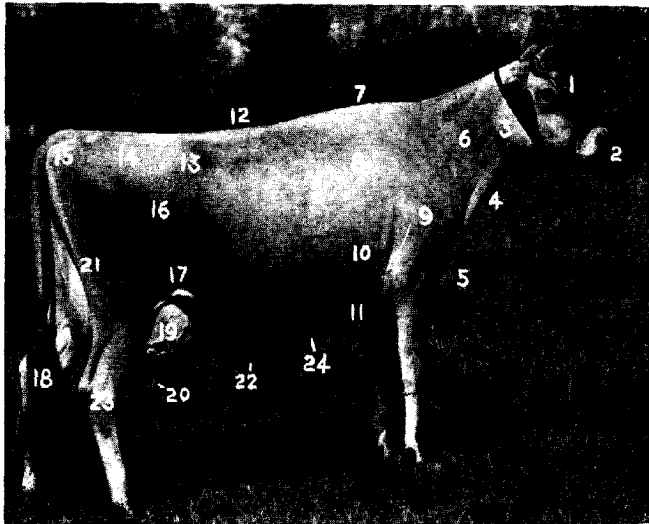
UNIVERSITY OF ILLINOIS
COLLEGE OF AGRICULTURE
Extension Service in Agriculture
and Home Economics



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PARTS OF A DAIRY COW



- | | | | |
|-------------|---------------|----------------------|---------------|
| 1. Forehead | 7. Withers | 13. Hip or hook bone | 19. Udder |
| 2. Muzzle | 8. Crops | 14. Rump | 20. Teat |
| 3. Jaw | 9. Shoulder | 15. Pin bone | 21. Thigh |
| 4. Dewlap | 10. Chest | 16. Stifle | 22. Milk vein |
| 5. Brisket | 11. Foreflank | 17. Flank | 23. Hock |
| 6. Neck | 12. Loin | 18. Switch | 24. Milk well |

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A DAIRY MANUAL

for 4-H Club Members

By C. S. RHODE and E. L. PILCHARD

A well-planned 4-H Club dairy project offers you many fine opportunities. If you stay with the project until you have cows in production, you will have learned the basic principles of dairying, picked up a great deal of practical information, and had valuable experience.

Some of you may find in a dairy project a chance to build up a business of your own. A number of 4-H Club members in Illinois who chose to work on the dairy project now have their own herds and businesses. A boy from Kankakee county, for instance, began a dairy project with a Guernsey calf when he was ten. He had a herd of thirty-two animals last year and had increased his production of butterfat from a herd average of 301 to 430 pounds. Now at nineteen, he has his own herd and a good start in his chosen business.

Of course, not all of you who enter a dairy project will choose to make dairying your business, nor even if you do, will you be able to go into it on as large a scale as did this boy. But what you learn from a dairy project will make you a better farmer and a better businessman.

GENERAL PROJECT REQUIREMENTS

Age. Any boy or girl 10 years old and not yet 21 as of July 1 of the current year can be a 4-H Club member and choose a dairy project.

Application. You can become a club member by filling out an application card. This card can be obtained from your local 4-H Club leader or from the farm adviser of your county.

If your first dairy project is to be the *dairy-production* project, you may give your card to the local leader and start anytime between October 1 and December 31 of the current year.

For the dairy heifer project, January 1 of the current year is the deadline. For the dairy calf project May 1 of the current year is the final date.

Care of animals. *You must personally own and care for the animals used in your project.*

Records. You will be required to keep a record of the kind, amount, and value of all feeds fed, of all money received and spent, and make notes on how you care for your calf, your heifer, or your herd. A book in which to keep these records will be furnished by your leader.

Exhibit. Every year you will be required to exhibit at least one of your club animals at a local or county 4-H Club show arranged by the local or county 4-H Club committee.

Turn in record. You will submit the complete record of your project (your completed record book) to your local leader by September 1, the end of the club year. The leader will then give this record to the farm adviser, who will return it to you after he has included it in his summary of the projects for your county.

HOW TO BEGIN

Decide what breed you want to work with. This is the first thing to do after you have enrolled in the local club. If you like one breed best, it is a good idea to choose it. If you have no real preference, you will find some advantage in selecting your calf or your heifer from the breed that is most numerous in your community.

Decide which project you want to enter. You can undertake any one of three projects: the calf project, the yearling heifer project, or the dairy-production or herd project. Before making up your mind, you will want to think over the situation on your home farm and choose the project that will fit best into the farm business.

Your age and experience will help you to make your choice. If you are old enough to have taken some responsibility for feeding and managing dairy cattle, you might like to choose the dairy-production project. The income from the milk or cream

For illustrations on pages 17, 29, and 30, the authors are indebted to the Public Service Company of Northern Illinois.

will make it possible for you to start early to pay off your debt for your stock.

If you have had only a little real dairy experience, you will want to enter the calf project. You won't have to invest so much in your animal, the requirements are lower, and you will have a chance to get experience while your calf is growing up.

Calf Project

Start not later than May 1. The calf must have been born after July 1 of the previous year. While it can be as young as you wish it to be, it is best for it to be not less than three months old, which would mean that it would be born not later than February 1 of the year you start your work.

Use either a heifer or a bull calf. Most club members choose heifer calves. A bull calf can be used but it must be a purebred registered calf. Also, choosing a bull calf means observing some special rules. You can get these rules from your farm adviser.

The use of a bull instead of a heifer calf may be best suited to boys and girls living on farms where there is not a good purebred sire. The calves are usually shown and sold at public auctions not later than October. This arrangement gives a club member a way to get his money out of his calf and gives his father a chance to buy it for the home herd.

When a bull calf is used, it is desirable to select one born as soon after July 1 of the previous year as possible.

Yearling Heifer Project

Start not later than January 1. The heifer project may be a continuation of the calf project, or you may buy a yearling heifer. The heifer must have become a year old between July 1 of the previous year and January 1 when the work starts. If you buy a heifer, your project should start on the day you buy it.

Dairy-Production Project

Continues yearling heifer project. Usually club members who have completed the yearling heifer project go on to the dairy-production project. But, if you wish to start with the dairy-production project, you may. This project is also known as the

herd project because once a heifer starts to produce calves she will normally continue to calve, thus increasing the number of animals you may expect to own in succeeding years. Furthermore, you may want to buy animals to add to your project.

Enrollment dates vary. If you bring a yearling heifer into the dairy-production project from the heifer project, you should start not later than October 1. If you start in 4-H Club work with the dairy-production project, you may enroll between October 1 and December 31; the project requires that one or more animals be in production for three or more months during the project.

Records. Besides keeping track of the amount of feed used for the heifer, you must keep a monthly milk and butterfat record from the date the heifer freshens. Directions for keeping these records are given on pages 16 and 17.

SELECTING CALVES

Most members start the dairy project with a calf. If you start your project with a calf, you will need to study carefully how to select the right kind of animal, for your success will depend a lot on this first step.

Get advice in buying your calf. Talk with some one who knows desirable dairy type, prices, and where you can get a good animal. Your father may give you this help, or you can see a local cattle breeder, the farm adviser, or the local vocational agriculture teacher.

Club members usually buy a calf locally when they can. Of course, you will want to buy one that you feel is priced right and is of the right type. You will also want one that has good inheritance and good health.

If you can't find such a calf in your community or county, you can usually get one in the state. If you get it from your father's herd, buy it just as you would if you got it from some other herd. If it is a purebred, see to it that you are listed as the owner on the records of the breed association. If you do not know where to get the kind of calf you want, write to the DAIRY DEPARTMENT, UNIVERSITY of ILLINOIS, Urbana, for help.

Guard against disease. When you select your calf, be careful not to get one that has been exposed to tuberculosis and brucellosis (Bang's disease). You can guard against both diseases by buying your calf from herds that are accredited as free from them and by buying on condition that the calf shall pass a 30- to 90-day retest for these diseases.

Keep your calf in quarantine until it has been retested and you know that the tests were negative. If you buy your calf from a herd infected with brucellosis, it will be best to have it vaccinated between the time it is 4 and 8 months old.

Select a Heifer Calf of Good Family

Choose a calf that will make a profitable dairy cow and a good foundation animal. Club members do not always agree on what kind of calf makes a good one for club work. Some, thinking that appearance in the ring is more important than the price they have to pay and evidence of ability to produce, want a calf that will stand at or near the top in the show ring. Others want a calf of good type from a cow with a good production record — they are more interested in building up a good herd than in taking prizes in the show ring. Still others are willing to get along with a very ordinary calf if it is cheap.

To get a calf of ideal quality — one that you can be quite sure will develop into a profitable dairy cow and become a good foundation animal — you will have to choose one with excellent ancestry. These are the qualifications for an ideal heifer calf:

1. It is a purebred as well as a good individual.
2. It was sired by a proved bull.
3. It is by a dam that was the daughter of a proved bull.
4. It is by a dam that has a mature record equal to 500 pounds or more of butterfat a year made on twice-a-day milkings.
5. It is by a dam that has one or more daughters with maturity records equal to 500 pounds or more of butterfat made on twice-a-day milkings.
6. It is by a sire and a dam that are both good individuals.
7. It is from a family that has good udders.

To get a calf of good quality. Only a few club calves, of course, are likely to measure up to the ideal just described. You may have to take a *good* one rather than an *ideal* one. Your

chances of getting a good one will be pretty high if you pick one that has quality and good ancestry. These are the qualifications for such a calf:

1. It is a good individual.
2. It was sired by a son of a proved bull.
3. It is from a dam that under good farm care has a mature record equal to 400 pounds or more of butterfat a year made on twice-a-day milkings.
4. It is from a sire and a dam that are both good individuals and that come from families with good udders.

Study the record of the calf's dam. To improve their herds, good dairymen study the production records of their cows. Then they use these studies as one of their guides when they have to decide what stock to keep and what they had best get rid of. Comparison of what the dam and the other cows in a heifer-calf's family have produced at maturity is one of your surest guides to a good calf.

When you study records of production, you look especially at the number of pounds of butterfat the cows produced in a year (a good cow should give at least 400 pounds). Have these questions in mind: (1) Were the records made on twice-a-day milkings or on more frequent milkings? (2) How often were the cows fed? (3) How old were the cows when the records were made? Good cows milked three times a day and properly fed will usually give 15 to 20 percent more milk than when they are milked twice a day. As a rule heifers with a first or second calf will not give as much as they will when they reach maturity (six to eight years).

If the dam of the calf you are thinking of buying is a heifer, find out how much milk you can normally expect her to give when she is mature and milked three times a day. The figures in Table 1 (page 9) will quickly show you about what she will produce. This is the way to work out this problem:

1. Put down the total number of pounds of milk the heifer produced during her lactation period.
2. Turn to Table 1. Find age of heifer in left-hand column.
3. Follow this line across the table until you come to the column showing her *breed*.
4. Put down the figure you find here; then multiply the heifer's total production by this figure. The answer is the heifer's expected production as a mature cow *milked three times a day*.

Example. Suppose you have a chance to buy a calf whose mother is a 3½-year old Holstein heifer. In 305 days she has given 11,378 pounds of milk on three-times-a-day milking. Her milk has averaged 3.7 percent butterfat, so that during the 305 days she produced 421 pounds of butterfat. *How much will she produce when she is mature?*

Go to Table 1 and get the figure given for a 3½-year old Holstein: 1.131. Multiply 11,378 pounds by 1.131 and you get 12,868.5 pounds, the amount of milk the heifer will give when she is mature and milked three times a day. If her milk continues to average 3.7 percent butterfat, she will produce 476 pounds of butterfat.

Multipliers to Use to Find the Number of Pounds of Milk a Young Dairy Cow Will Produce at Maturity (Table 1)

Multiply the pounds of milk the young cow produced during her lactation period by the figure given for her age and breed.

Find age at calving multiply by:	For Brown Swiss, Milking Short-horn multiply by:	For Ayrshire, Guernsey, Jersey multiply by:	For Holstein multiply by:	For Mixed breed multiply by:	Find age at calving multiply by:	For Brown Swiss, Milking Short-horn multiply by:	For Ayrshire, Guernsey, Jersey multiply by:	For Holstein multiply by:	For Mixed breed multiply by:
Yrs.					Yrs.				
2.....	1.538	1.262	1.377	1.319	9.....	1.006	1.024	1.054	1.039
2½.....	1.400	1.195	1.275	1.232	9½.....	1.012	1.035	1.072	1.051
3.....	1.286	1.141	1.203	1.172	10.....	1.030	1.047	1.090	1.068
3½.....	1.196	1.099	1.131	1.115	10½.....	1.048	1.064	1.114	1.089
4.....	1.136	1.063	1.077	1.070	11.....	1.072	1.082	1.138	1.110
4½.....	1.088	1.037	1.035	1.036	11½.....	1.096	1.100	1.162	1.131
5.....	1.052	1.020	1.017	1.018	12.....	1.114	1.112	1.192	1.152
5½.....	1.028	1.008	1.006	1.006	12½.....	1.132	1.124	1.222	1.173
6.....	1.012	1.000	1.000	1.000	13.....	1.144	1.136	1.252	1.194
6½.....	1.006	1.000	1.000	1.000	13½.....	1.156	1.148	1.282	1.215
7.....	1.000	1.000	1.006	1.000	14.....	1.168	1.160	1.306	1.233
7½.....	1.000	1.006	1.012	1.006	14½.....	1.174	1.172	1.330	1.251
8.....	1.000	1.012	1.018	1.015	15.....	1.180	1.184	1.348	1.266
8½.....	1.000	1.018	1.036	1.027	15½.....	1.186	1.193	1.366	1.278
					16.....	1.192	1.199	1.378	1.288

Since cows milked and fed three times a day give more milk than those fed and milked twice a day, *your next step is to find out how much the heifer will give on twice-a-day milking when she is mature.* To find out, turn to Table 2, page 10:

1. Find the line in the column on the left which includes a 305-day milking period.
2. Follow this line over to the *milked three-times-a-day* column and get your figure, .8333.
3. Multiply 12,868.5 pounds (the amount produced at maturity) by .8333. The answer, 10,723 pounds, is what the heifer will normally produce at maturity in 305 days *on twice-a-day milking.*

Multipliers for Reducing Records of Frequently Milked Mature Cows to What Their Production Would Be on Twice-a-Day Milking (Table 2)

Find total number of days your cow was milked	If your cow was milked 3 times a day, multiply by:	If your cow was milked 4 times a day, multiply by:	Find total number of days your cow was milked	If your cow was milked 3 times a day, multiply by:	If your cow was milked 4 times a day, multiply by:
5 to 15	.9903	.9831	156 to 165	.9024	.8408
16 to 25	.9839	.9721	166 to 175	.8971	.8328
26 to 35	.9776	.9614	176 to 185	.8918	.8249
36 to 45	.9713	.9509	186 to 195	.8866	.8171
46 to 55	.9652	.9406	196 to 205	.8815	.8096
56 to 65	.9591	.9306	206 to 215	.8764	.8021
66 to 75	.9531	.9208	216 to 225	.8714	.7948
76 to 85	.9472	.9111	226 to 235	.8665	.7876
86 to 95	.9414	.9017	236 to 245	.8616	.7806
96 to 105	.9356	.8925	246 to 255	.8567	.7736
106 to 115	.9299	.8834	256 to 265	.8520	.7668
116 to 125	.9242	.8746	266 to 275	.8472	.7601
126 to 135	.9187	.8659	276 to 285	.8425	.7536
136 to 145	.9132	.8573	286 to 295	.8379	.7471
146 to 155	.9077	.8490	296 to 305	.8333	.7407

If as a mature cow she continues to give milk that averages 3.7 percent butterfat, her yield of butterfat will be about 397 pounds. Tho a cow that gives about 400 pounds of butterfat is not a high producer, she is a satisfactory one, and on the basis of her production you would be justified in buying her calf.

Each time you buy a calf study the production record of the dam and of the other cows in the calf's family. Your goal is to increase your production of butterfat. Remember that while a cow that gives 400 pounds of butterfat a year is a good cow, an excellent cow gives 500 pounds or more.

Choose Heifers With Characteristics of Good Cows

Heifers and heifer calves are undeveloped, and consequently there is not as much to see about them as about mature cows. They have some of the same characteristics as good cows, however; therefore if you know how to pick a cow of good dairy type, you can learn how to choose heifers and heifer calves.

Characteristics of a good dairy cow. In a good dairy cow, look for these things: (1) a stylish appearance, (2) an open conformation, (3) a roomy digestive system, and, (4) a good udder and mammary system.

Stylish appearance. A dairy cow which has the following features is *stylish*:

1. A feminine-looking head
2. A clean-cut neck, free from throatiness
3. Shoulders that blend nicely with her body
4. A strong, straight back and loin
5. A long, level rump with the tailhead set smoothly between the pinbones
6. Straight hind legs
7. Thin, incurving thighs
8. A well-proportioned body
9. A large, well-attached udder

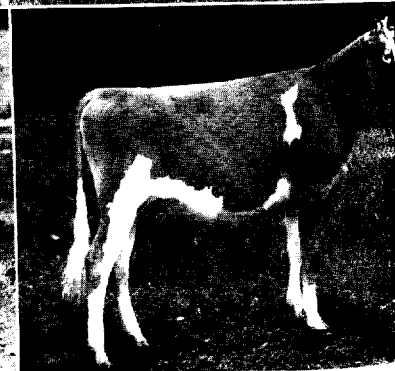
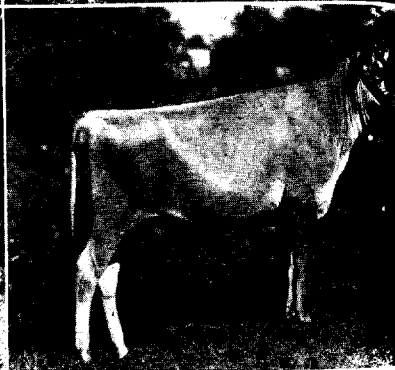
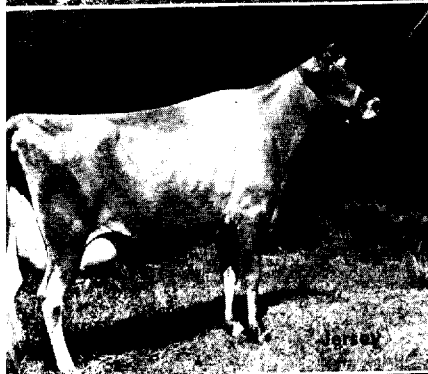
Open conformation. A cow's frame or build is called her *conformation*. A dairy cow which is *open* in conformation is one which has clean features about the head, a fairly long, thin neck, clean-cut shoulders, sharp withers, a prominent backbone, hips, and pinbones, and ribs that are open or well apart.

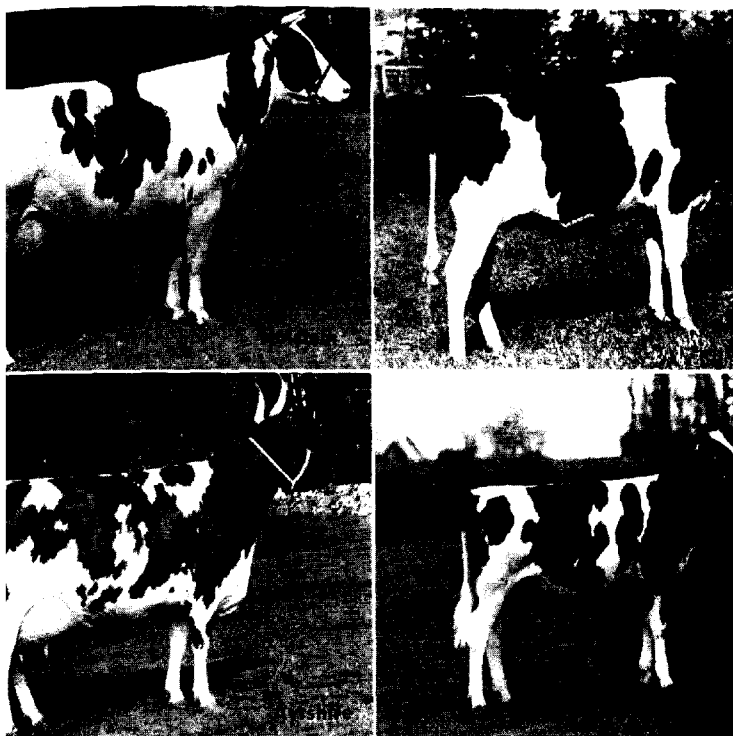
A roomy digestive system. A good dairy cow needs a roomy digestive system. A deep, wide middle or barrel, and a wide, strong muzzle show she has it. A cow with a rounded, shallow body will not have a roomy enough digestive system to take care of as much food as she will have to eat to be a good cow. A dairy cow is a manufacturing plant. She changes large quantities of rough feeds, such as pasture, hay, and silage into valuable human food. A good dairy cow has to have room enough to handle these feeds if she is to give a great deal of milk.

To digest lots of feed, a good dairy cow needs a heart, lungs, arteries, and veins that are well developed. She must have a wide, deep chest to let her heart and lungs develop.

Since the milk she produces is carried in her udder, she needs one that is large and well attached. If there is anything seriously wrong with it, she will not be as useful and valuable as she ought to be. A good cow almost always has a capacious udder. And it should be of good quality, not meaty and coarse. When it is milked out, it should hang in loose, pliable folds. It should be attached high and wide behind, be reasonably level on the bottom, and carried well forward and smoothly attached to the body. The teats should be large enough for hand-milking and well placed on each quarter.

A good udder and mammary system. A cow's udder, milk veins, and milk wells are known as her mammary system. The





FIVE MAJOR BREEDS OF DAIRY CATTLE

The five cows pictured here are outstanding representatives of their breeds. All have exceptionally good mammary systems: note the splendidly attached and capacious udders, well-placed teats, and the veining on udders and abdomens. All show the triangular conformation desired in dairy animals; that is, a straight top line and a bottom line that tilts upward toward the front. The clean-cut heads and necks, thin thighs, and open ribbing indicate outstanding dairy character.

The heifers should all develop into promising cows. They have the lines, the conformation, and the clean-cut heads and necks that characterize good dairy animals. Notice that all have depth of body, alertness, "feminine" looking heads, straight lines, good legs, and general balance.

milk veins running forward from her udder on her abdomen carry her blood from her udder to her heart. Large veins, milk wells, and veining on her udder indicate that there is a large circulation of blood thru her udder.

Look out for the defects listed below:

Lack of dairy type	Body shortcomings	Poor mammary systems
Coarse, compact bodies of beef type	Narrow, shallow chests	<i>Udders are —</i>
Coarse, steery heads	Low backs	Coarse and meaty
Short, thick necks	Low, narrow loins	Small and short
Heavy, coarse, open shoulders	Badly sloping rumps where the pinbones are much lower than the hip bones	Narrow and attached low at rear
Coarse bone structure	Narrowness at pinbones and thurls	Low-hanging and badly quartered
Thick, rounding thighs	Coarse, heavy tailheads	Poorly developed fore or rear quarters
	Shallow, rounding bodies	Pull away from abdomen
	Crooked hind legs	Very large or very small teats
		Small milk veins
		Cows that are hard milkers

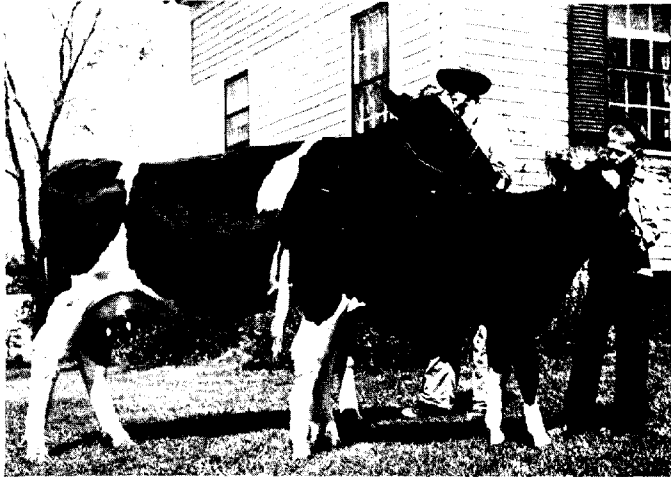
Look for style, conformation, and barrel in heifers and heifer calves. The mammary system in a heifer calf is not developed. Moreover, a heifer does not show as much angularity as a dairy cow. Your good heifer calf, however, will have the same *style, conformation*, and the *deep, wide barrel and chest* that you find in a good cow. An alert heifer with a clean-cut head and neck, a deep body, and a straight, strong back and rump will usually develop into a good cow.

Buyers often turn down calves because they are thin and not as attractive as those which carry more flesh. Don't let lack of condition keep you from buying a calf that promises to become a good cow. Flesh and finish is one thing and good dairy type another. Don't confuse the two.

Insure Your Calf

As soon as you have bought a calf or one has been born into your herd, protect yourself against its loss. Always insure it. You may use one of two kinds of insurance:

1. You may become a member of a cooperative insurance company. The cooperative plan provides that every member shall



When choosing a heifer for your Club project, it is sound dairy practice to compare her with her dam. In that way you can get an idea of the kind of animal your heifer is likely to develop into.

pay 8 to 10 percent of the original cost of the animal into a county sinking fund. If you should lose your calf, your loss is paid from this fund.

2. You may insure your calf with a livestock insurance company. Your coverage should date either from the time you buy your calf or from the time it is born. This is important, for if you buy a calf, your loss might occur before it is delivered to you. Most companies will not insure a calf for more than \$100. You can get more information about insurance from your farm adviser.

KEEP ACCURATE RECORDS

As a club member, you will get a book in which you can keep an accurate record. The book includes tables from which you can get all the information you will need for various dairy projects: calf, heifer, and dairy-production. It tells you how to keep a good record and is planned so that, if you have more than one animal in your project, you can keep all the records in one book.

If you are a member of a dairy-production project, you may also get forms suitable for keeping daily milk-production records. You may get both the book and the forms from your farm adviser.

Keep your feed separate. If you are a beginner, you will need to know how to keep your feed record. The best and easiest way is to keep a two weeks' supply of feed in a special box or barrel. Then, when you add a supply of grain to the box, weigh the feed you add and put its weight in the proper table in your record book. If you are careful to put your feed weights in the right table, you will find keeping an accurate feed record easy.

Don't try to feed your calf from the supply kept for your father's herd.

Let production record be your guide. When your heifer has freshened, your record will require more attention. It will show how much milk and butterfat your heifer produces during the year. Her production record can guide your feeding. If you have more than one animal in your project, keep a separate record for each one in production. Keep a record of all young animals in one record book.

A good dairyman uses his records to improve his herd. You will need your records for the same purpose. You will find the discussion on pages 8 to 10 helpful when you have to decide whether to keep or discard an animal.

To measure production. One of your most important jobs as a producer of dairy products is that of measuring the amount of milk and butterfat your cow gives. The first thing to do is to get the equipment you need. You will have to have a 30- or a 60-pound milk scale that will weigh down to one-tenth of a pound; a half-pint fruit jar with a tight-fitting lid; and some preservative, such as formalin.

Each time you milk, weigh the milk and write the weight on the barn sheet. (*The barn sheet will be given to you with your record book and other forms.*)

About a week after your heifer has freshened, put a sample of her milk from both the night and morning milkings in your fruit jar and fasten the lid. Before you take a sample, stir the

Keep a record of the amount of milk your cow gives. This is a very important part of any plan for improving a herd.



milk thoroly by pouring it from one pail to another three or four times. Unless you do this the result of the test will be misleading and you will not get accurate figures for the percentage of butterfat in the milk.

During the period of her production, take a sample of your heifer's milk once a month on about the same day of the month as that on which you took the first sample. During warm weather, use a preservative, such as formalin, to keep the sample from souring. Ten drops of formalin to a half pint of milk is enough. **CAUTION:** Formalin is poisonous; keep it away from children.

You can usually get your samples tested at a local cream station, milk plant, or creamery. If your father is in a dairy herd improvement association, the association tester will take your milk samples and figure out how much butterfat your heifer is producing every month. If you have to do your own testing, see your club leader about the testing equipment you will need and find out how to make the tests from him.

FEEDING DAIRY ANIMALS

When you finish your dairy-calf club project, you will be responsible for feeding new-born calves, heifers 4 to 8 months old, yearling heifers, heifers in milk, and young calves. In the following pages, you will find suggestions for feeding animals of all these ages.

Feeding Young Calves

See that a newly born calf gets the colostrum, or first milk, from its mother. The first milk contains vitamin A and essential foods that the newly born calf needs; it is important that the calf get this first milk.

Leave the calf with its mother for two or three days. Then if it is normal, take it away from her and teach it to drink from a bucket. You will find it easier to teach it to drink from a nipple pail; tho if you do not let it drink too fast, you can use an ordinary bucket. To keep it from drinking too fast, put or hold the bucket about a foot from the ground.

Don't overfeed. Overfeeding a very young calf is a serious mistake. Guard against it. For the first week, feed $\frac{3}{4}$ of a pound of milk for each 10 pounds the calf weighs. During the first week, give the milk in equal feedings three times a day. After the first week you can increase the feed to one pound of milk for each 10 pounds the calf weighs.

Feed skimmilk or dried milk, grain, and hay. Start your calf on whole milk. After it is three weeks old gradually cut down the amount of whole milk you feed it until it is on skimmilk, grain, and hay, or dry calf starter and hay. By the time you get it on skimmilk your calf will be 7 to 10 weeks old. It usually takes 350 to 400 pounds of whole milk to get a calf well started.

Feed your calf grain as soon as it will begin to nibble at it. If you are going to feed it skimmilk, use a grain mixture similar to one of those listed on page 20. If you are going to put it on dry feed, then use a grain mixture that has some dried milk in it. A mixture that has been used successfully in the University of Illinois dairy herd is made up as follows:

	Pounds		Pounds
Ground yellow corn.....	25	Brewers' yeast.....	2
Rolled oats.....	30	Salt.....	1
Alfalfa leaf meal.....	10	Ground limestone.....	1/2
Linseed meal.....	15	Steamed bonemeal.....	1/2
Soybean meal.....	6	Irradiated yeast.....	1/10
Dried skim milk.....	10		

When the calves are $3\frac{1}{2}$ to 4 months old, they should be changed gradually to one of the mixtures listed on page 20.

When it is about three weeks old, give your calf all the hay it will eat. Feed the hay in a rack or manger. Early-cut clover, clover and timothy, or properly cured alfalfa are all valuable calf feeds. They have vitamins A and D in them, things your calf needs if it is to be strong. You can also feed green, leafy alfalfa hay, but if you do, you will have to be careful to feed it so that it will not scour your calf.

A calf that gets plenty of early-cut, well-cured hay and whole milk usually has the vitamins it needs. Since cod-liver oil helps to build up resistance to calfhood diseases, you will find it a good plan to add enough to provide 500 units of vitamins. Directions on the container will tell you how much it will take to make 500 units.

See that your calf can always get to salt and to plenty of fresh, clean water.

Feeding Calves Four to Eight Months Old

If your calf is well grown when you buy it, you will want to continue to feed it on the same ration that it had been on before you got it. If you don't have the same feeds, or if it had not been fed a practical ration, you will have to change the ration.

Feed skim milk. Skim milk is such a valuable part of the ration that you can continue to feed it until your calf is 5 or 6 months old. After that age, most calves will make satisfactory growth without it. But if you feed skim milk to your calf until it is 5 or 6 months old, be sure to get it used to other feeds before you take it to the show. Changing a ration sometimes affects a calf's digestive system or its appetite. If you should have to put it in the ring when its digestion is out of order or it is off-feed, it will not make as good a showing as it would otherwise.

Feed hay. Feed your calf all the good-quality legume or mixed hay that it will eat. Legume hay is the most important of all the roughages for dairy calves. It gives them the protein, minerals, and vitamins they need for proper growth. If your calf has a tendency to scour when you feed it legume hay, you can cut down the amount of legume hay and add nonlegume (Sudan grass, bluegrass, oat hay, redtop, etc.) or mixed hay to its ration. If you have corn silage, you can feed 5 to 10 pounds of it daily. Don't feed straw, fodder, timothy, and other poor-quality hays; they are not good for dairy calves.

If you have an older calf that is on good pasture during May and June, it will need very little, if any, hay. Later on during hot weather and fly time, feed legume hay in a comfortable, darkened stall and see that the calf can get to it at any time. Feed grain thru the summer.

Feed grain mixtures. Make your grain mixtures for 4- to 8-month old calves mostly of farm-grown feeds. You will want to use farm-grown feeds as much as possible because they are usually the cheapest. Farm grains, however, do not have enough protein in them. You can make up for the shortage by adding such feeds as bran and linseed or soybean meal.

The grain mixtures given below are recommended for young heifers. You can easily make them at home.

Ration 1		Ration 2	
	Pounds		Pounds
Ground yellow corn.....	400	Ground oats.....	200
Ground oats.....	400	Ground yellow corn.....	200
Wheat bran.....	100	Linseed meal.....	50
Linseed meal.....	50	Bran.....	50
Soybean meal.....	50	Bonemeal.....	5
Bonemeal.....	10	Salt.....	5
Salt.....	10		

The amount of grain that you feed daily will depend on the condition and growth of your heifer. You want to keep her in good condition but not fat. A safe rule is to feed one pound of grain a day for the first 100 pounds of her weight and $\frac{1}{2}$ pound more for each additional 100 pounds she puts on. Whether you should add to or lower these amounts will depend on her condition.

Provide water and salt. Be sure that your calf can always get plenty of clean, fresh water. And be sure that she can get clean, pure salt whenever she wants it. It is a good idea to keep it in a box nailed to one corner of her stall.

Feeding a Yearling Heifer

Summer. A yearling heifer (or a two-year old) will make satisfactory growth in the summer on good pasture alone. When the pastures are poor, however, you will need to feed her some legume hay, silage, or grain to keep her in good condition. Legume hay is a good feed to add to her ration when pastures are poor.

Late fall and winter. In late fall and winter feed your yearling heifer legume hay, and if you have it, silage. If you do not have silage, feed her all the good-quality legume hay she will eat. Plenty of green, leafy legume hay will give her the calcium, and most of the protein and vitamins she needs for proper growth and development. If your legume hay is poor or if you have to use nonlegume roughages, feed her $\frac{1}{2}$ - to 1-ounce of special bonemeal or finely ground limestone every day.

Besides legume hay and silage if you have it, your heifer may need, in late fall and winter, a limited amount of grain if she is to stay in a thrifty condition. Two pounds of grain a day will usually be enough. The same grain mixture that is used for the home herd is all right for yearling heifers if it is carefully balanced to fit the kind and quality of roughage which you have. Some mixtures are suggested on page 23.

These three feeds — legume hay, silage, and a grain mixture — make an almost ideal winter ration for a yearling heifer.

Feeding a Bred Heifer

Give your bred heifer enough to eat so that the calf, when it is born, will be strong and active. And remember that your heifer is not yet full grown. She has to grow to her normal size and carry a calf at the same time.

Don't let your heifer get thin. She can only do all she has to do if you keep her in good condition. The month before she is to have her calf is especially important. During this last month

the unborn calf is making its most rapid growth. This is the time to add to the hay and grain ration.

Two weeks before the calf is due, take away most of the grain. Leave corn and barley out of the ration entirely. Continue to feed the heifer hay and let her have as much of it as she wants. A good grain ration for this last two weeks is: 1 part ground oats and 1 part wheat bran; or 2 parts ground oats and 1 part linseed meal.

Feeding Cows for Production

The way a dairyman feeds his cows makes a difference in the amount of milk they produce and in the profit that he makes. Your aim in your dairy-production project should be to supply high-quality roughage and a balanced grain mixture in large enough amounts to enable the cows to produce at their *inherited* ability.

Keep feeds in balance. Good-quality legume hay and silage, if you have it, can form the basis of a suitable ration for cows from which you want high production, just as they do for the ration of young heifers. Of course, if your cow or heifer freshens during the summer months, good pasture should be her main feed. In winter, besides silage and plenty of good-quality hay, you will need to feed a suitable grain mixture. The best mixture to use will depend on the kind and quality of the roughage you have, on the farm grains at hand, and on the price of protein concentrates, such as linseed, soybean, and cottonseed meals.

If you can give your cows all the bright-green alfalfa hay they will eat, you will not need to include as much protein in the grain mixture as you would if you were to feed roughage of poor quality. That is why you should take the quality of the roughage into account when you prepare a grain mixture.

The grains grown on Illinois farms — corn, oats, and barley — should be used as much as possible in the dairy ration. These feeds, however, are rather low in protein. To build up the amount of protein in the ration, it is usually necessary to mix farm grains with high-protein supplements such as linseed, soybean, and cottonseed meals.

The grain mixtures given below have been planned to meet

the herd's requirements under various common systems of feeding hay and roughage.

Legumes, no silage. If you have no silage but can supply all the good legume hay your cows will eat, feed one of these mixtures; they contain about 12 percent total protein.

Ration 1	Pounds	Ration 2	Pounds
Corn and cob meal.....	600	Corn and cob meal.....	500
Ground oats.....	400	Ground oats.....	300
Soybean meal		Linseed meal.....	50
or		Cottonseed meal.....	50
Linseed meal.....	100	Salt.....	14
Salt.....	17		

Legumes and silage. If you feed legume hay and corn or sorghum silage, use one of these mixtures; they contain about 15 percent total protein.

Ration 1	Pounds	Ration 2	Pounds
Corn and cob meal.....	700	Corn and cob meal.....	800
Ground oats.....	700	Ground oats.....	500
Soybean meal.....	100	Soybean meal	
Cottonseed meal.....	100	or	
Linseed meal.....	100	Cottonseed meal.....	300
Salt.....	26	Salt.....	24

Roughage of poor quality. If your roughage is timothy hay, weedy or badly damaged legume hay, corn or sorghum silage, mixed timothy and clover hay, corn or sorghum fodder, use one of these mixtures: they contain about 16½ percent total protein.

Ration 1	Pounds	Ration 2	Pounds
Corn and cob meal.....	500	Corn and cob meal.....	400
Ground oats.....	300	Ground oats.....	300
Linseed meal.....	200	Linseed meal.....	100
Soybean meal.....	100	Soybean meal.....	100
Salt.....	17	Brewers' grains.....	100
Bonemeal.....	11	Salt.....	15
		Bonemeal.....	10

Feed according to production. You will want to adjust the amount of the grain mixture that you feed to the amount of milk that your cows produce. Failure to make this adjustment

will either cause you to waste feed or lose milk. Your best guide to the amount of grain to feed is the amount of milk your cows produce every day. Holstein, Brown Swiss, and Ayrshire heifers usually need one pound of grain for each $3\frac{1}{2}$ to 4 pounds of milk they produce daily. Jersey and Guernsey heifers usually need one pound of grain for each $2\frac{1}{2}$ to 3 pounds of milk that they produce daily.

Your dairy cows are usually at their best during May and June, when there is plenty of pasture. Then the conditions for producing milk and butterfat are ideal. The cows like the taste of grass and it supplies the proteins, minerals, and vitamins they need. But even when pastures are good, you will need to feed heavily producing heifers some grain. The grain will keep them from losing flesh as quickly as they otherwise would and it will help them to produce better thruout their next lactation period. **A good mixture to feed during the early pasture season is 2 parts of ground corn or barley to one part of ground oats.**

If your heifers are producing less than one pound of butterfat a day, they will get along nicely on pasture alone.

As the season advances, the make-up of the common pasture grasses changes, and so you will need to change your grain mixture to meet the change in grass. **A good mixture for the late summer months is this:**

	Pounds
Ground corn or ground barley . . .	600
Ground oats	300
Linseed meal	100
Soybean meal	100
Salt	10

If you feed legume hay and silage besides a grain mixture, you may use the same mixture that you use in the winter. Give your heifers enough feed while they are on pasture to keep them from getting thin and to keep their milk flow from falling off.

Plan a pasture program. Since good pasture is such an important feed for dairy cows and since production costs are lowest when cows are on good pasture, you and your father should think your pasture program over very carefully.

You can greatly improve your permanent pasture by liming

and disking, and seeding sweet clover and other legumes. A few acres of rye seeded in late summer or early fall will give you good pasture for 10 days or 2 weeks in early spring. As soon as your cows eat the rye down, you can plow it under. A week or 10 days after you have worked the ground down well, you can seed it to Sudan grass. Plowing the rye under before it ripens and holding up the sowing of Sudan grass for a week or 10 days will help you to avoid any damage from chinch bugs. In a normal season your Sudan grass will be ready to pasture 5 or 6 weeks after you seed it and will give you a pasture of high quality during the hot summer months.

Feed all your dairy stock well, both your young stuff and your mature animals. Your young stuff cannot grow and develop as it should without the right feeds and enough of them. As a producer, you will have to feed well if you are to reach your goal, which is to produce large quantities of milk and butterfat at low cost.

CARING FOR A CALF AND A HEIFER

Caring for a Calf

As soon as the calf is dropped, paint the navel cord with iodine to prevent infection. If the mother does not lick the calf dry, rub it dry with a cloth or clean, dry straw.

Much of the care a small calf needs has to do with its feeding. For instructions concerning feeding, see pages 18 and 19. Let the calf exercise in the sun. A calf needs both exercise and sunlight if it is to be strong-bodied.

Give your calf good quarters. After you take the calf away from its mother, put it in a clean, dry, well-lighted place. The quarters do not need to be fancy, but they ought to be roomy, clean, light, dry, and well ventilated. Use a box stall if you can. A box stall gives the calf more freedom than a stanchion or a narrow stall, and your calf will do better, keep cleaner, and be more contented in it than in smaller quarters.

Clean and disinfect the stall thoroly before you put the calf in it. Caution now may prevent trouble later on. Clean the stall every day and put in fresh, dry bedding. A wet, dirty stall is unhealthful and uncomfortable. You may darken the stall during the summer months when the weather is hot and the flies are bad.

You may protect your calf against the flies still more by covering it with a light burlap blanket.

Make your calf a pet. Your calf will do better if you make a pet of it. Handle it often and be kind to it and it will be your friend. Successful dairymen are kind to their cattle. Besides, making a pet of your calf will be an advantage to you at show time. You will not want to show a wild, unruly, and poorly trained calf.

Give your calf good care. Your calf is like a baby; it needs sanitary care and surroundings and proper feeding. To insure your calf's health, follow these sanitary precautions:

1. Provide a clean, sanitary place for the calf to be born in.
2. Before the calf nurses, wash the dam's udder and teats thoroly with a chlorine solution.
3. Prevent infection by applying tincture of iodine to the calf's navel cord as soon after the calf is born as you can.
4. Keep the calf in a clean, dry, well-bedded stall.
5. Feed the calf from a clean pail.
6. Do not let one calf suck another.

To be sure that your calf is properly fed, follow the instructions for feeding given on pages 18 and 19.

Caring for a Heifer

You will have had some interesting experiences before you reach the heifer project if you began club work with a calf and have gone thru a year of club work with it. Besides the experience of raising the calf, you will have learned some things at the county show and will be looking forward to your second year's work with a yearling heifer.

Don't breed your heifer too young. Let the breed and growth of your heifer guide you when you decide at what age she should drop her first calf. Breeding her too early may make her undersized since producing milk tends to hold back a heifer's growth.

You may safely breed a well-grown, thrifty heifer, however, earlier than one less well grown.

Jerseys mature earlier than other breeds and may usually be bred when they are 15 to 17 months old. A heifer bred at 15 to 17 months will drop her first calf when she is 24 to 26 months old.

Holsteins and Brown Swiss need more time to develop properly. They should not calve before they are 28 to 30 months old. Guernseys and Ayrshires should not be bred as young as Jerseys, but they may be bred sooner than Holsteins and Brown Swiss.

Breed your heifer to a good bull. If you are to lay the foundation for a high-producing, valuable dairy herd, choosing the bull to which you breed your heifer is most important. Breed her to the best bull that you can get her to. If necessary, take her several miles for breeding.

The bull you choose should be a proved one. A proved bull is one that is already the sire of daughters who have production records higher than their dams, who in their turn were high-producing cows.

Three cooperative breeding associations in Illinois supply semen for artificial breeding. You can probably have one of them supply you with semen. The bulls these cooperative associations use are selected with great care by a committee of experienced breeders.

From the start, outline and follow a breeding program which will improve the type and the production of the animals that your cows calve.

Good feeding highly important. With a bred heifer good management is mainly a matter of good feeding. For the proper feeding program, see pages 21 and 22.

Be very careful not to get your heifer too fat before calving time. If you feed her heavily until she drops her calf, she is likely to have a badly caked udder and a weakened udder attachment.

Special care needed at calving time. During the summer, a pasture which has plenty of shade is a good place for your heifer to calve. Take her away from other cows at calving time. If you have no other pasture or if she is to freshen at some other season of the year, give her a clean, disinfected box stall, bedded down with plenty of clean straw. Put her in the stall a few days

before she is due to freshen so that she will become familiar with her new surroundings. Do not disturb her at the time she calves, but see to it that someone is nearby who can help her if she needs help.

As soon as the calf is born, give the heifer a bucket of lukewarm water to which you have added a handful of salt.

The physical energy of your heifer is likely to be lowered after she calves. If the weather is cold, protect her from cold drafts and blanket her. For a day or two she will need only legume hay of good quality and a little bran mash.

As soon as the fever leaves her udder, you may safely start to feed her small amounts of the regular grain mixture. Slowly increase her daily feeding until she gets food enough to meet her needs for full production. Bringing her to full production may take two or three weeks or even longer.

MANAGING A HERD

Your herd will include one or more cows in production. It will probably also include calves, heifers, yearlings, and perhaps a bull. When, in the dairy project, your herd consists of animals of these ages, you will be a dairyman in fact. As a dairyman, your future will depend on: (1) your plans for increasing the productiveness of your herd; (2) your system of keeping records; (3) your culling of low-producing animals; (4) your use of outstanding sires; (5) your adherence to a strict sanitary program; and (6) your keeping the herd free from disease.

To manage your herd well you will need to have mastered the knowledge and the skills discussed on the previous pages of this manual. You will also need to know how to set up and stick to a strict program of sanitation and understand how to keep your herd free from disease.

A Strict Program of Sanitation

A strict program of sanitation is important for three reasons. *First*, it assures you that the milk you produce will be of high quality. Milk of high quality is more profitable than milk of poor quality. Since as a dairyman your main purpose is to produce milk and butterfat at a profit, a good sanitation program

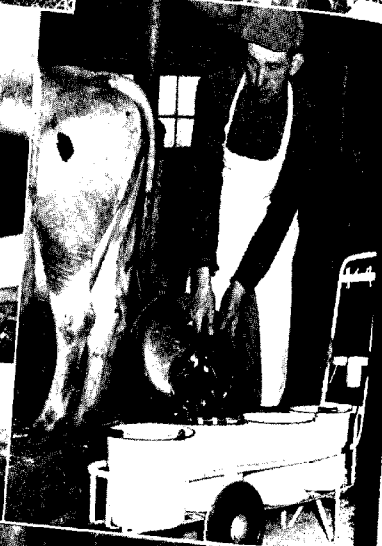


Daily liming of the barn floor helps to keep down barn odors and prevents many bacteria from developing. The hand spreader insures a good job and saves labor.

Clipping around udder and hindquarters makes it easier to keep cows clean.



Scrubbing the floor and gutter occasionally with hot lye water helps to destroy bacteria.



**GOOD
MILKING
PRACTICES**

may mean extra dollars. *Second*, milk is human food. As a dairyman, your duty to your community requires you to furnish it a clean, pure food. *Third*, a good program of sanitation helps to maintain healthy udders and to prevent the spread of disease.

A good program of sanitation demands that you keep the stalls, barn, and cows clean and that you milk in a certain way.

Keeping stalls, barn, and cows clean. Disease germs live in filth. Clean premises and clean animals help to keep milk clean and to prevent disease. To keep the premises and the animals clean, you will have to do these things:

1. Remove soiled bedding and sweep the gutters and floor every day.
2. Lime the gutters and floor behind the gutters.
3. Use plenty of dry bedding.
4. Disinfect the floors, walls, stanchions, and mangers.
5. Keep lots next to the barn dry and clean.
6. Keep the cows clean and well groomed.

Milking the right way. Correct milking calls for the right equipment. Make sure that you have all the things listed below. Some dairymen find that putting these items on a cart that can be pulled along the milking line saves time and labor.

1. A pail of chlorine water (250 parts chlorine to one million parts water) at 130° F. Directions for getting this dilution are given on the chlorine container.
2. A cloth for each cow
3. A pail for used cloths
4. A pail of lukewarm water
5. A pail of warm chlorine water
6. A strip cup

Use this system. To milk correctly, you must follow the steps given below every time you milk. You must follow them exactly and must not skip any.

1. Wash and gently massage the cow's udder and teats with a cloth dipped in very warm chlorine water (130° F.).
2. Place the cloth in the used-cloth pail.
3. Take one or two full-hand squeezes into the strip cup (*never milk on the floor*). Using the strip cup helps to produce

clean milk, spots cows giving abnormal milk, and stimulates the cow to let down her milk.

4. Apply milking unit immediately. (If you milk by hand, follow Steps 1, 2, and 3. Dry hands before milking, complete milking with full-hand squeezes, and wash hands before milking next cow.)

5. Allow milker to remain on cow about 3 minutes. Just before removing the milker, pull down gently on teat cups with one hand while massaging the udder downward with the other.

6. Dip the teat cups in lukewarm water, then into the pail of warm chlorine water, and apply milker to the next cow which has already been prepared for milking as described above.

7. Check the cow just milked for completed milking, using full-hand squeezes.

8. Dip each teat into chlorine water (250 parts of chlorine per million parts of water). Use fresh chlorine water for each cow.

Use right kind of utensils and keep them clean. These two precautions are very important if you are to produce clean, pure milk. (1) Use a seamless bucket and strainer. (2) Wash each thoroly after you use it and rinse it in water containing a chlorine sterilizer. Inverting utensils on a rack to air is an old dairy practice and a good one. Rinse your utensils out with clean, pure water before you use them next.

Testing for, Preventing, and Controlling Disease

Make sure animals added to herd have been tested. Before you let any new animals come in contact with a healthy home herd, be very sure that they have been tested for tuberculosis, brucellosis (Bang's disease), and mastitis. Most contagious diseases get into healthy herds when infected animals are added to it.

Many successful dairymen quarantine animals to be added to their herds until they are sure that the new animals do not have a contagious disease. If for any reason they suspect that an animal in the herd may have developed one of these diseases, they isolate it immediately and disinfect the premises.

Watch for signs of disease. Successful dairymen are constantly on the alert for any sign of disease in their herds. Three of the most costly diseases of dairy cattle are *tuberculosis*, *brucellosis*, and *mastitis*. If you have had your animals tested for tuberculosis and brucellosis at the time you bought them (see pages 6 and 7) and have had the calves born into your herd tested, you have taken a most important first step toward maintaining a healthy herd. To keep your herd healthy, have your animals tested for tuberculosis and brucellosis at regular intervals.

Plans for controlling brucellosis are offered by the Illinois Department of Agriculture in cooperation with the Federal Bureau of Animal Industry. If you need to use one of these plans, have your local veterinarian help you choose the best one for you (what is best for your herd will depend on many things). But no matter which plan you adopt, you will need to use sanitary management and blood testing at intervals.

Blood testing does not show the difference between reaction to vaccination and to natural disease. If some of your vaccinated calves are later blood tested and continue to show a positive reaction to the blood test, assume they have the disease.

Vaccination is not usually recommended for clean herds. Altho vaccinating calves helps to control brucellosis, it will not take the place of good management and herd testing.

Mastitis, or garget, is one of the most serious diseases of dairy cattle. It is believed to be caused by bacteria which enter the udder thru the teat canal. The symptoms are clotted and watery milk, a "caked" bag, heat, pain, and swelling in the udder. To prevent your cows from getting mastitis, keep your barn, stalls, and gutter clean; use plenty of bedding; and milk your cows in the way described on pages 31 and 32.

Treat common diseases promptly. Many of the common and minor diseases of dairy cattle you will be able to prevent if you stick to the sanitary measures outlined on pages 28 to 32. If one of the common diseases does appear, treat it promptly.

Scours. One of the most common diseases of calves is the scours. There are several causes of this disease: overfeeding; feeding from dirty pails; feeding milk at varying temperatures; feeding milk too

rich in butterfat; feeding sour or dirty milk; feeding milk with separator foam on it; feeding too much leafy legume hay; allowing the calf to drink too fast; and keeping the calf in cold, damp, drafty quarters.

When a calf gets the scours, put it in a stall away from other animals and cut its rations in half. Give it about a half teacup of mineral oil to which you have added $\frac{1}{2}$ to 1 tablespoonful of a mixture made of two parts bismuth-subnitrate and one part salol. In bad cases of scours, repeat the dosage in 6 to 12 hours.

As soon as the calf's condition returns to normal, bring it back to full feed. Find and remove the cause of the disease. Enriching the ration with vitamins may help to prevent some cases of scours.

Ringworm. Ringworm is caused by a fungus. It usually appears about the animal's head and neck as small, yellow, crusty areas, which vary from $\frac{1}{4}$ - to 1-inch or more in diameter.

Wash these crusts with soap and water to remove them. Then apply sulfur ointment or tincture of iodine every other day for several days. Radiator alcohol or vinegar is also effective.

To prevent the disease from spreading, keep the infected animals separated from the others and thoroly disinfect the stalls and halters and anything that may spread the disease from one animal to another. Human beings can get ringworm from animals. To protect yourself, wear rubber gloves when you handle infected animals or materials.

Warts. Warts are horny-like growths that appear on the surface of the skin. They can sometimes be rubbed off with sweet oil or castor oil. Sometimes a 10 percent salicylic acid solution applied weekly will remove them. Wart vaccines, given by veterinarians, are also helpful. In severe cases, warts may have to be cut off.

Lice. Lice annoy a calf, lower its ability to resist disease, and slow its growth. They are most common in winter.

You can usually control lice by dusting a louse powder along the calf's back and rubbing it into the hair with a brush; or you can rub the powder in by stroking the hair in the direction opposite to that in which it lies. To kill lice hatched after the first dusting, repeat the treatment in about a week. During mild, comfortable weather, you may get rid of lice by washing the calf in a solution of one part lysol to fifty parts water. Dry the calf thoroly afterwards.

Extra teats. Rudimentary, or extra, teats detract from the appearance of a cow's udder. Remove them when the heifer is young. Tie a piece of thread or wrap a rubber band tightly around the base of the extra teat. In a few days it will fall off. A veterinarian often cuts extra teats from milking cows.

GOING TO THE SHOW

The opportunity to show your calf at the 4-H Club show or fair is one of the great advantages of dairy club work. Going to a show gives you a chance to compare your calf with the calves of other club members or exhibitors. There you can check the condition, training, and growth of your calf against that of others in the show. You can see the strong and weak points of your own calf. From your experience at the fair you can learn more about desirable dairy type.

Prepare for the Show

Make your entry properly. If you are going to exhibit at a 4-H show or a fair, don't fail to fill out your entry form if one is required and it usually is. You can get a form for a 4-H show from your farm adviser and one for a fair from the secretary of the fair.

Start preparations eight weeks before the show. Your calf should look its best at the show. To be ready for showing, it must be in condition, properly fitted, and carefully trained. It will take you eight weeks to get your calf ready.

Keep your calf indoors in a comfortable stall during the heat of the day; if possible, darken the barn to help keep out the flies.

Begin early to teach your calf to lead readily. Teach it to stand squarely on its feet with its head up so that it will show to best advantage in the ring. To teach your calf to show properly, you will have to handle it often and use a great deal of patience. It is a good plan to spend a few minutes every day in training your calf. A showman and his animal should understand each other thoroly.

Give special attention to feeding. Getting just the right amount of flesh on a young animal to make it show well is not hard if you have given it the right care. While you don't want your calf to be too fat, you do want it to carry flesh enough to have a good, thrifty, sleek look. Changing the ration a month before the show will help put the calf in condition to show well and will improve the appearance of the hide. A good grain ration to use is: 5 parts wheat bran, 3 parts ground oats, 1 part ground corn, and 1 part linseed meal.

How much you feed will depend on the condition of the calf. Use plenty of clover hay or mixed hay. If your calf shows any tendency to "looseness" on this ration, reduce immediately the amount of feed it gets.

Attend to hoofs and horns. Neat, shapely horns add to the appearance of your calf. If your calf's horns have a tendency to be out of shape, you can use horn trainers (if you use them properly) to help bring them into correct position.

To polish a calf's horns, first scrape them with a piece of broken glass or a steel scraper; then use some common sandpaper to make them smooth. Next rub them with fine emery paper. Last, polish them with strips of cotton flannel, pumice stone, and a little sweet oil. Rub the horn seesaw fashion with the cloth and pumice stone for three or four minutes; put some oil on the horn and with a second piece of flannel seesaw as before; then with a dry cloth, go on rubbing until you get the right polish.

Sometimes the horns of older heifers are long and coarse. It is then advisable to shorten them slightly and reduce them to a desirable size and shape. To shorten and size them, use a rasp with a rounded side.

Your calf should stand with natural ease. If its hoofs have



Before the show sandpaper your calf's horns, and clip it around its head and ears to give the head a refined, clean-cut look.

grown in such a way that it cannot so stand, trim them. Polish and clean them before you lead your calf into the ring.

Improve the quality of your calf's hide. About a month before the time for you to show your calf, blanket it heavily until its skin becomes soft and pliable; then use lighter blankets. Take the blankets off every day and thoroly groom the calf. Use soft brushes, soft cloths, a little sweet oil, and plenty of hand rubbing. Two or three weeks before the show give the calf a good washing and continue grooming and rubbing.

Clip if necessary. If you have groomed your calf properly, you will not need to clip it very much. (A calf will rarely need to be clipped completely.) Your calf will show to best advantage if its tail, belly, face or head, and neck have been clipped. To clip the tail, begin a few inches above the place where the long hairs of the switch start; don't clip too high on the tail.



A lot of brushing is needed to get your calf ready for the show. Brushing takes the dirt from the hair and hide and stimulates circulation. Good circulation improves the quality of the hide and makes it pliable.

Observe the health regulations. The Illinois state law demands that before animals can be exhibited at fairs and other shows, they must meet certain health requirements, particularly requirements concerning tuberculosis and Bang's disease. Find out well ahead of fair time what the health regulations are and comply with them.

Take the equipment you will need. Some time before you take your calf to the show, make a list of the equipment you will need there. Your list will include: a water bucket, feed bucket, blanket, hand clippers, flashlight, show halter, soap, comb and brush, bottle of sweet oil, sandpaper, emery paper, flannel cloths, and a pitchfork.

At the Show

After the calf is unloaded at the fairground, see that it is well bedded in a comfortable stall. Keep the stall clean and neat at all times. Visitors appreciate cleanliness. Furthermore, nothing detracts more from an exhibit than dirty, poorly kept quarters.

Feed the same feeds at the show that the calf was used to getting at home. Taking enough grain with you to last thruout the show is a good plan; it lessens expense and you don't have to change the ration.

At the show never water your calf from a common water tank or trough. Water it from your own bucket and let no one else use the bucket. Don't let your hay be scattered around where visitors or other exhibitors will walk on it. Simple precautions such as these will help you avoid trouble from infectious diseases.

The day before the show there will be plenty of work to do. See that your calf is especially well bedded; and to keep it from getting dirty, see that all soiled bedding is promptly removed. You will probably need to give the calf's horns some attention, tho you should not put on the final polish until the morning of the show. Wash the switch on the calf's tail thoroly and braid it into two or three tight braids of even size. Work a string into each braid so that the braid can be tied. Don't comb the tail out until just before the judging.

Feed your calf a little salt the night before the show and don't give it all the water it wants. You want to show your calf

with the proper fill. Feeding a little salt and withholding some water will stimulate the calf's appetite for water the next morning and assure getting the proper fill.

Show day. Find out the exact time the calves are to be shown. Then give yourself plenty of time to "dress up" your calf. Clean it thoroly, comb out the switch, put the final polish on the horns and hoofs and see that the show halter and other equipment you need are ready. Do not forget that as a showman you should also be neat and clean.

Water your calf just before you lead it into the ring. Be careful not to let it drink too much; it will probably have a big appetite for water, but too much will make it look bloated and keep it from showing to good advantage.

In the ring. When the time comes to show, be ready to lead in promptly. Keep your calf looking its best all the time. If you have trained it properly before the show, you won't have to work with it all the time you are showing it. Never allow it to slump; slumping may affect its placing.



Showing your animal at Club and county fairs gives you a chance to compare its growth and condition with that of other good animals.

After the awards have been made, inspect the other calves. Try to see what makes one better or less good than another. Comparing calves in this way is more important than prize money, for the most valuable thing the show can do for you is give you a chance to learn more about dairy animals. Since the calves will be shown another year, what you learn at the show one year will improve your chances of placing higher the next time. Of course if you were at the top this year, you will probably need all the help you can get to enable you to make top place again next year.



Take every chance to join in judging contests. There is no better way to get experience in evaluating dairy animals. These 4-H boys are judging Guernsey cows in front of the dairy barns at the University of Illinois.

PEST CONTROL IN COMMERCIAL FRUIT PLANTING



Circular 623

UNIVERSITY OF ILLINOIS • • • COLLEGE OF AGRICULTURE
EXTENSION SERVICE IN AGRICULTURE AND HOME ECONOMICS

In cooperation with ILLINOIS STATE NATURAL HISTORY SURVEY

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*For weekly radio and mail reports on control
of insects and diseases, see page 37*

AUTHORS

Dwight Powell, Assistant Professor of Plant Pathology, Department of Horticulture, College of Agriculture, University of Illinois.

S. C. Chandler, Associate Entomologist, Illinois State Natural History Survey.

Victor W. Kelley, Associate Professor of Horticulture Extension, Department of Horticulture, College of Agriculture, University of Illinois.

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PEST CONTROL

In Commercial Fruit Plantings

PART I

INSECT AND DISEASE CONTROL

EVERY ILLINOIS FRUIT GROWER who expects to make a success of his business must carry thru a vigorous program of pest control every year. Each year the need for control measures becomes greater. In some kinds of orchards attention must be given this problem every season of the year.

Fortunately better methods of pest control are being constantly worked out by various experimental agencies. This circular brings together the latest recommendations from the Illinois and Indiana Agricultural Experiment Stations, the Illinois Natural History Survey, and the U. S. Department of Agriculture. Some growers may need to adjust these recommendations to suit their own special conditions; but they are urged not to experiment with untested materials and methods. To do so is likely to lead to disaster.

CONTROL IN APPLE ORCHARDS

Sanitation More Important Than Spraying

Spraying is absolutely necessary in apple orchards, but sanitation is even more important. With the introduction of DDT for codling moth control, many growers have stopped sanitation measures. This is a mistake, for no grower can get full benefit from spraying unless he is willing to do the following things:

Remove all rough and loose bark from crotches, trunks, and branches. Do this "barking off" during the winter or by May 1. Go high enough on the tree to get all bark that is so rough as to harbor codling moth larvae. Removing rough bark does two things: (1) destroys a large share of the overwintering larvae of the codling moth; and (2) prepares the trees for banding.

Directing a straight stream of water under high pressure against rough bark is an excellent way to remove it from apple trees. With power spray equipment, the rough bark can be taken from mature apple trees in 2 to 4 minutes in this way. Standard spray guns fitted with a disk that has an $\frac{3}{16}$ -inch opening (No. 8 disk) should be operated at 500 to 600 pounds pressure at or near the full open position. Take care not to hold the gun in one position too long, as water at this pressure may tear thru the solid bark. This method is excellent for removing punky wood and for cleaning out crotches and the area around the base of the tree near the ground line.

Scraping bark off by hand takes so much work and time that that method is being largely replaced by the water spray.

Thin out branches and reduce height of tall trees (Fig. 1). This will make it easier to get a good coverage of spray. Thinning is especially important in orchards where spraying is done by the nonstop system, whether a "speed-sprayer" is used or the usual equipment.



Fig. 1.—Tops of high trees should be lowered for convenience in spraying and harvesting. Fruit trees should not be allowed to grow more than about 20 feet high. The cure for trees that have done so is to cut the leaders back to horizontal lateral branches (see arrows). If the cutting is so heavy as to expose too much of the top to the sun, the branches may sunscald. It is of course much better to prune lightly when the tree first begins to grow too high.

Collect and burn all prunings and other debris. Destroy broken crates, baskets, discarded sacks, weed stems, cornstalks, cobs, etc.

Screen or plug cavities. This will prevent moths from escaping to the orchard. Screen may be tacked over large cavities. Smaller cavities may be plugged. For information on plugging material write the ILLINOIS NATURAL HISTORY SURVEY, Urbana, Illinois.

Store orchard crates and used baskets in a closed building. This will keep moths from escaping back to the orchard. Most of the moths can be collected and destroyed by darkening the building and hanging a light over a pan of kerosene. If crates are not stored in a closed building, dip the corners in fuel oil or kerosene. Stack props as far as possible from the orchard.

Screen the packing shed — if it is in the orchard and fruit was allowed to remain in the shed for any length of time during the harvest period.



Fig. 2. — Chemically treated bands 2 to 4 inches wide are effective in killing codling moth larvae on trees that have had bark removed from trunks, crotches, and branches.

Band trees. Banding will reduce the summer broods of codling moth larvae 50 percent. Apply treated bands (Fig. 2) normally about June 10 to 30. The time for each section of the state will be announced by radio.

Thin out and destroy all damaged fruit as soon as discovered—fruit showing disease, insect injury, or rot. Break up fruit clusters.

Collect and remove all dropped fruit at frequent intervals. Do not let culls accumulate around packing shed.

Avoid coarse mulching materials. Clip sweet clover or other cover crops to prevent rank stem growth in which codling moth larvae might spin cocoons.

Two Apple Borers Need Watching

There are two apple tree borers of importance in Illinois. Altho neither is always present in apple orchards, both may cause very serious injury on trees up to about 12 years of age.

The roundheaded apple tree borer is prevalent mostly in the northern two-thirds of Illinois. The burrows of this insect are usually made in the base of the trunk. They extend from 1 to 2 inches below the ground level to a foot or more above ground. To control this insect pour $\frac{1}{2}$ pint of paradichlorobenzene-oil solution (see *lesser peach borer*, page 18) around the base of the tree, touching the bark. Mound 3 to 5 spadefuls of earth over the treatment. CAUTION: This treatment is likely to injure the tree unless the bark is in a moist condition at the time of treatment.

The flatheaded apple tree borer works higher up on the trunk than the roundheaded borer and sometimes infests the branches. This borer nearly always locates on the sunny side of a tree, tho infestations may extend completely around a tree. Some degree of control can be obtained by shading the trunk, either by wrapping it or by placing two boards, nailed together in the form of a trough, near the trunk to shade the south and west sides. Weakened trees are especially susceptible to this borer. No satisfactory wash or paint is known for killing the larvae in the tree or for repelling the adults.

Grasshopper Control

During the past two or three years grasshoppers have been troublesome in many orchards. To control these pests, apply chlordane at the rate of $\frac{1}{2}$ to 1 pound an acre, preferably in a spray form, when the young hoppers are relatively numerous. In any case, make this application, if possible, before the hoppers are grown.

Chlordane leaves a residue that will prevent new invasions of hoppers from adjoining fields for about 2 weeks.

Spray Schedules for Fall and Winter Varieties

STANDARD SCHEDULE

• **Dormant.** Apply when the trees are dormant (Fig. 4, before Stage 1) and when the spray will dry before freezing. Early spring is safest time and most effective.

For oystershell, scurfy, and San Jose scale (Fig. 3), green or rosy apple aphids, European red mite, in 100 gallons of water use:

Dormant oil, 3 gal. actual oil, *plus either*

DNC (3,5 dinitro-o-cresol), 1 lb. actual DNC

— or "Elgetol," $\frac{3}{4}$ gal. (see page 35)

For single pests, in 100 gallons of water use:

Dormant oil, 2 to 3 gal. actual oil (San Jose scale alone)

Dormant oil, 3 gal. actual oil (European red mite alone)

"Elgetol," $\frac{1}{2}$ gal. with or without oil (aphids alone)

Dormant oil, quick-breaking type, 4 gal. actual oil (fruit tree leaf roller)

For apple scab, apply to the ground only, in the spring before the first leaves appear, at the rate of 500-600 gallons per acre. In 100 gallons of water use:

"Elgetol," $\frac{1}{2}$ gal.

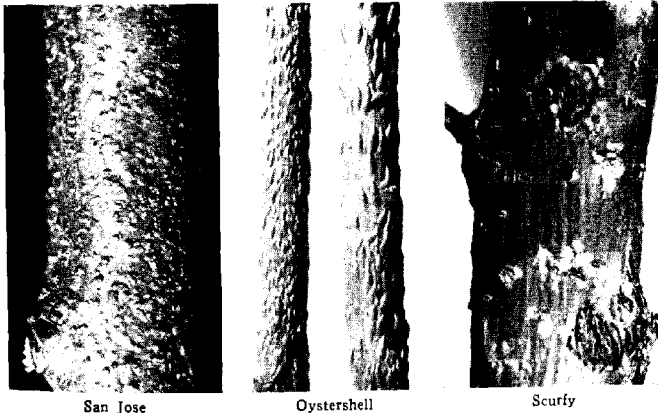


Fig. 3.—The three most important fruit-tree scales in Illinois. San Jose scale is the most destructive. Oystershell scale is of importance only in the northern half of the state. Scurfy scale causes little damage in well-sprayed orchards.

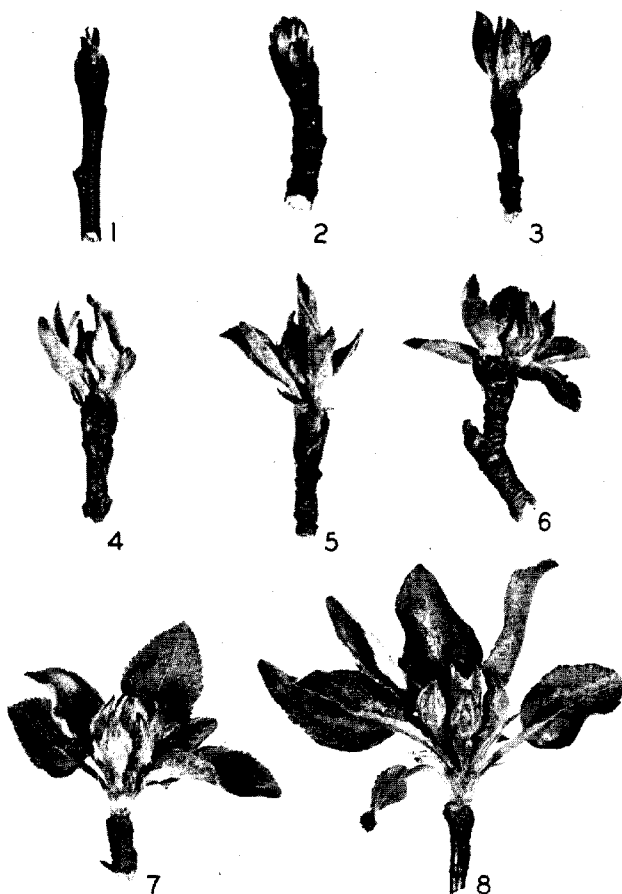


Fig. 4.—Time apple sprays with development of fruit buds. Apply the strictly dormant sprays before Stage 1. Apply delayed dormant sprays during Stage 2. Apply prepink spray between Stages 3 and 6. Start the pink spray at Stage 7 (not later than 8), and complete by the time the first flowers open.



Fig. 5.—Three types of apple scab on leaves. (1) Diffused irregular spots. (2) Spots diffused but especially prominent along leaf veins. The most severe spray injury results when caustic sprays are applied to leaves showing this type of scab. (3) Well-defined spots; note also lesions on leaf stem.

•**Prepink.**¹ This spray is for apple scab (Fig. 5). Apply before the flower buds show pink (Fig. 4, Stage 3) and complete before the flowers separate in the cluster (Fig. 4, Stage 6).

For apple scab only, in 100 gallons of water use:

Commercial liquid lime sulfur, 2 gal.

— or dry lime sulfur, 8 lb.

— or "Puratized Agricultural Spray," 1 pt. (see page 36).

•**Pink.** Apply as soon as most of the buds in the cluster have separated (Fig. 4, Stages 7-8). This spray is primarily for apple scab but may also be used for cankerworm.

For apple scab, in 100 gallons of water use:

Same as prepink spray

— or flotation sulfur paste, 16 lb.

— or microfine wettable sulfur, 8 lb.

Do not use lime sulfur on Jonathan or Golden Delicious.

¹In problem orchards apply sulfur dusts between prebloom sprays as a supplementary scab-control measure.

For apple scab and for cedar rust and quince rust where these diseases are a problem, apply the following materials instead of the full-strength sulfur. In 100 gallons of water use:

"Fermate," $\frac{1}{2}$ lb., *plus either*
Microfine wettable sulfur, 3 lb.
— or flotation sulfur paste, 6 lb.

- **Bloom.** *Do not use lead arsenate in this spray.*

For apple scab apply the following spray if cold damp weather prevails following the prebloom stages, thus prolonging the blooming period. In 100 gallons of water use:

Flotation sulfur paste, 10 lb., or microfine wettable sulfur, 5 lb.

For fire blight apply the following spray to susceptible varieties when 20 percent of the blossoms have opened. In 100 gallons of water use:

Copper sulfate, 2 lb. Hydrated lime, 4 lb.

For cedar rust, quince rust, and apple scab control on varieties susceptible to cedar rust, in 100 gallons of water use:

"Fermate," $\frac{1}{2}$ lb., *plus either*
Microfine wettable sulfur, 3 lb.
— or flotation sulfur paste, 6 lb.

- **Calyx.** Apply when $\frac{3}{4}$ of the petals have fallen (Fig. 6), and complete before the calyx lobes close on the most advanced fruit (Fig. 7).

For codling moth, apple scab, curculio, fruit tree and red banded leaf roller, and green fruitworm, in 100 gallons of water use:

Lead arsenate, 3 lb.
Hydrated lime, 3 lb., *plus either*
Flotation sulfur paste, 12 lb.
— or microfine wettable sulfur, 6 lb.

For cedar rust, quince rust, apple scab, and codling moth, in 100 gallons of water use:

Lead arsenate, 3 lb.
"Fermate," $\frac{1}{2}$ lb., *plus either*
Microfine wettable sulfur, 3 lb.



Fig. 6.—Time to apply calyx spray for scab and codling moth. Petals have just fallen but calyx lobes are still open.



Fig. 7.—Too late for calyx spray. The calyx lobes have closed.

• **Calyx top-off.** Apply this to the top $\frac{1}{3}$ of the tree immediately after the calyx spray. Use the same materials as recommended for the calyx spray unless oil is to be used in the second cover spray. If it is, substitute in this spray 1 pound of "Fermate" for the sulfur and omit the lime.

Use a top-off after as many other sprays as practicable.

• **First cover.** Apply 7 days after the calyx top-off spray. (Northern Illinois growers see page 14.)

For euireulio, codling moth, scab, blotch, cedar apple rust, fruit tree and red banded leaf roller, in 100 gallons of water use:

Lead arsenate, 4 lb. "Fermate," 1 lb. (see page 35)

Soybean flour, $\frac{1}{4}$ lb.

Following this spray choose *either* the lead arsenate - nicotine

schedule (*below*) or the DDT schedule (*page 13*). Use the DDT schedule if you have a high carryover of codling moth.

**LEAD ARSENATE - NICOTINE SCHEDULE FOR
FALL AND WINTER APPLES^a**

Application and purpose	Time to apply	Materials in 100 gallons of water
2d cover , for codling moth, red banded leaf roller, curculio, leafhopper, scab and blotch	Approximately 7 days after 1st cover (<i>see spray service report for proper timing</i>)	Lead arsenate, 4 lb. "Fermate," $\frac{1}{2}$ lb. Summer oil, 2 qt. (<i>see page 35</i>) DDT, $\frac{1}{2}$ lb. actual (<i>for leafhopper</i>)
3d cover , for codling moth	7 days after 2d cover	Same as for 2d cover except omit DDT
4th cover , for codling moth	7 days after 3d cover	Lead arsenate, 2 lb. Summer oil, 2 qt. — plus either — "Black leaf 155," 3 lb. — or nicotine sulfate (40%), 1 pt. Mississippi bentonite, 8 lb.
5th cover , for codling moth	7 days after 4th cover	Same as 4th cover except omit lead arsenate
5th cover top-off , for codling moth	7 days after 5th cover	Same as for 5th cover
6th cover , for codling moth	7 days after top-off	Same as for 5th cover
Special sprays where bitter rot is expected	7 days after 5th cover and repeat at intervals of 10 days for at least 4 applications	"Fermate," 2 lb.
2d- and 3d-brood codling moth sprays	Start 1st application 2 weeks after 6th cover. Make 2 to 4 applications 10 to 14 days apart, depending on abundance of codling moth	"Black leaf 155," $2\frac{1}{2}$ lb. Summer oil, 2 qt. — or — Mississippi bentonite, 5 lb. Summer oil, 2 qt. Nicotine sulfate (40%), $\frac{2}{3}$ pt.

^a The federal government has established spray-residue tolerances of .025 grain of arsenic trioxide (As_2O_3), .05 grain of lead (Pb), .21 grain of copper (Cu), and .05 grain of fluorine (F) per pound of fruit.

Directions for washing apples can be obtained by writing to the DEPARTMENT OF HORTICULTURE, ILLINOIS AGRICULTURAL EXPERIMENT STATION, Urbana, Illinois.

DDT SPRAY SCHEDULE FOR FALL AND WINTER APPLES

Application and purpose	Time to apply	Materials in 100 gallons of water
2d cover , for codling moth, red banded leaf roller, leaf-hopper, curculio, scab and blotch	Approximately 7 days after 1st cover. See spray service report	Lead arsenate, 2 lb. DDT $\frac{1}{2}$ lb. actual (see page 35) "Fermate," $\frac{1}{2}$ lb. Soybean flour, $\frac{1}{4}$ lb.
3d cover , for codling moth, red banded leaf roller	7 days after 2d cover	Lead arsenate, 2 lb. DDT, $\frac{1}{2}$ lb. actual Copper sulfate, $\frac{1}{2}$ lb. Hydrated lime, 1 lb. Summer oil, 2 qt.
4th cover , for codling moth	7 days after 3d cover	Same as for 3d cover
5th cover , for codling moth	7 days after 4th cover	Same as for 3d cover if codling moth is severe — or — "Black leaf 155," 3 lb. Summer oil, 2 qt. — or — Mississippi bentonite, 8 lb. Nicotine sulfate (40%), 1 pt. Summer oil, 2 qt.
Special spray if mites have appeared	Following 5th cover	"DN 111," $\frac{3}{4}$ lb. (see page 35)
5th cover top-off	7 days after 5th cover	Same as for 5th cover
Special sprays where bitter rot is expected	7 days after 5th cover and repeat at intervals of 10 days for at least 4 applications	"Fermate," 2 lb.
2d- and 3d-brood codling moth sprays	Start 2 weeks after 5th cover top-off; make 2-3 applications at 10-12 day intervals (see spray service report)	DDT, $\frac{1}{4}$ lb. to $\frac{1}{2}$ lb. actual Summer oil, 2 qt. — plus either — "Black leaf 155," $1\frac{1}{2}$ lb. — or — Mississippi bentonite, 4 lb. Nicotine sulfate (40%), $\frac{1}{2}$ pt.
Special spray if mites are abundant	Following 2d- and 3d-brood sprays	"DN 111," $\frac{3}{4}$ lb.

NORTHERN ILLINOIS SPRAY SCHEDULE FOR FALL AND WINTER APPLES

(For dormant, prepink, pink, calyx, and calyx top-off sprays, use same materials as in standard schedule, pages 7-11.)

Application and purpose	Time to apply	Materials in 100 gallons of water
1st cover , for curculio, apple scab, codling moth and leaf roller	7 days after the calyx top-off	Lead arsenate, 3 lb. Hydrated lime, 3 lb. Soybean flour, $\frac{1}{4}$ lb., — plus either — Flotation paste, 10 lb. — or microfine sulfur, 5 lb.
2d cover , same as 1st cover	7 to 10 days after 1st cover	Same as 1st cover. If leafhoppers are present, add DDT, $\frac{1}{2}$ lb.
3d cover , for codling moth and apple scab	7 to 10 days after 2d cover	Lead arsenate, 3 lb. Hydrated lime, 3 lb. Soybean flour, $\frac{1}{4}$ lb., — plus either — Flotation sulfur paste, 4 lb. — or microfine sulfur, 2 lb.
4th cover , for codling moth and apple maggot	7 to 10 days after 3d cover	Same as 3d cover
Special sprays for European red mite and two-spotted mite	When mites appear to be abundant	"DN 111," $\frac{3}{4}$ lb. (see page 35)
2d-brood codling moth and apple maggot spray	(Follow weekly spray service report)	Lead arsenate, 3 lb. Hydrated lime, 3 lb. Soybean flour, $\frac{1}{4}$ lb.

A simple way to figure amount of spray for apple trees:
For prepink spray, divide age of tree by 4 to find gallons needed per tree. For pink spray, divide by 3; for calyx, divide by 2; for succeeding sprays, divide by 1.5. Example: a 10-year-old tree should be given the following amounts:

Dormant and prepink stages.....2.5 gallons
Pink stage.....3.3 gallons
Calyx stage.....5.0 gallons
Each succeeding spray.....6.7 gallons

Summer Apples

SPRAY SCHEDULE

(For dormant applications use those listed for fall and winter varieties.)

Application and purpose	Time to apply	Materials in 100 gallons of water
Delayed dormant , for blotch in heavily infected orchards	As late as possible, before too many leaves appear	Copper sulfate, 12 lb. Hydrated lime, 12 lb. "Dendrol" dormant oil, 2 gal.
Prebloom , for scab	When buds show the first pink	"Fermate," 1½ lb. (see page 35) — or — microfine sulfur, 8 lb.
Calyx , for scab, blotch, codling moth and green fruit worm	When ¾ of the petals have fallen	Lead arsenate, 3 lb. "Fermate," 1 lb. Soybean flour, ¼ lb.
1st cover , for codling moth, curculio, scab, and blotch	7 days after calyx spray	Same as calyx spray
2d cover , for codling moth and blotch	10 days after 1st cover	Same as 1st cover
3d cover , for codling moth	7 to 10 days after 2d cover	"Black leaf 155," 3 lb. Summer oil, 2 qts. — or — Nicotine sulfate (40%), 1 pt. Summer oil, 3 qts. — or — Calcium arsenate, 3 lb. Hydrated lime, 3 lb.
4th cover , for early 2d-brood codling moth	(See spray service report)	Same as for 3d cover

Don't forget to thin your fruit! Getting rid of surplus, defective, and low-quality fruit takes a big load off the tree. Limbs will rise, allowing better air circulation in tree. Sprays will dry faster. Spray injury will be reduced. Besides, fruit will be better color, size, and quality; picking costs will be lower; there will be less low-quality fruit on the market to discourage buying.

Guard Against Spray Injury

1. Keep trees in **good vigour**.
2. Keep trees **well pruned** to get maximum air circulation for good drying.
3. Use **mist** sprays — do not apply sprays in a stream.
4. Do **not** apply lime sulfur when temperature is **90° F. or above**.
5. Do **not** apply bordeaux mixture, lead arsenate, or lime sulfur during periods of **slow drying**.
6. When using "Fermate" or DDT with oil, **always add the oil last**, just before the tank is completely filled with water.
7. Do **not** let oil sprays with DDT or "Fermate" **stand in the tank** before using.
8. Always apply dormant oil sprays in **early spring**, never in the fall.
9. When using lead arsenate and lime sulfur in combination, **add hydrated lime**.
10. Never spray in the rain **except** with mild wettable sulfurs when they are necessary for apple scab control.
11. Do **not** use sulfur **with oil**. Never spray with oil within 10 days of the last sulfur spray.
12. Do **not** use DDT or "Fermate" **with miscible oil sprays**.
13. Do **not** use lime sulfur on Jonathan or Golden Delicious **after the prepink spray**.
14. Do **not** use "Fermate" **in combination with** bordeaux mixture or within a week before or after bordeaux mixture.
15. **DO NOT EXPERIMENT** — use all spray materials according to directions.

SPRAY SCHEDULE FOR PEARS

Application and purpose	Time to apply	Materials in 100 gallons of water
Dormant , for pear psylla and scale	Before buds begin to open. Not needed every year	Dormant oil, 2 gals.
Calyx , for codling moth, curculio, leaf spot, and pear scab	As soon as petals have fallen	Lead arsenate, 3 lb. Hydrated lime, 3 lb. Microfine sulfur, 8 lb. — or — Lead arsenate, 3 lb. "Fermate," 1½ lb. (see page 35) Soybean flour, ¼ lb.
1st cover , for codling moth, curculio, leaf spot, and pear scab	10 to 12 days after calyx spray	Same as for calyx
2d cover , for codling moth, leaf spot, and scab	14 days after 1st cover	Lead arsenate, 3 lb. "Fermate," 1 lb. Soybean flour, ¼ lb.
3d cover , for codling moth, leaf spot, and scab	14 days after 2d cover	Lead arsenate, 3 lb. Copper sulfate, 1 lb. Hydrated lime, 2 lb. Summer oil, 2 qt.
Additional sprays		
— for codling moth and leaf spot.....	Same as for 2d-brood codling moth on apple, if necessary	Same materials as 3d cover
— for psylla.....	When nymphs are visible on water sprouts	Tetraethyl pyrophosphate ¼ lb. actual (see page 36) Summer oil, 2 qt.

PEACHES AND APRICOTS

Borer Control

Borers are serious pests in all parts of the state where peaches and apricots are grown. There are three borers to consider.

The *peach borer*, which also attacks plums, cherries, and nectarines, is the most serious and the most common. It works at the base of the tree. Excellent control is obtained by applying crystalline paradichlorobenzene (P.D.B.) to the ground in a ring around the tree just far enough from the trunk so that it does not touch the bark, and then mounding with 3 to 5 spadefuls of earth (Fig. 8). Depending upon the circumference of the tree, use the following amounts of P.D.B. on:

Trees 1 year old, $\frac{1}{4}$ oz.	Trees 6 to 10 years old, 1 oz.
Trees 2 years old, $\frac{1}{2}$ oz.	Trees older than 10 years,
Trees 3 to 5 years old, $\frac{3}{4}$ oz.	1 to 2 oz.

Fall treatments are more effective than spring treatments. The temperature of the soil should be 55° F. or over to volatilize the material. In general, the best dates for treatment are from September 25 to October 15, depending on the latitude and soil temperatures.

The *lesser peach borer* works farther up on the trunk or in the crotches and injured places over the tree. It can be controlled by painting the affected areas with P.D.B. in oil made up as follows: dissolve 2 pounds of P.D.B. in 1 gallon of "Dendrol," or similar oil, and make up to 2 gallons with water.



Fig. 8.—P.D.B. treatment for peach borers consists of a "death ring" of paradichlorobenzene crystals (*left*) placed close to the trunk of the tree *but not touching the bark*. The ring of crystals is covered with a mound of earth (*right*) to confine the gas. (If you cannot obtain P.D.B., write to the ILLINOIS NATURAL HISTORY SURVEY, Urbana, Illinois, for directions for using ethylene dichloride.)

Bark beetles usually attack only weakened trees or branches, tho occasionally they are found on healthy trees. Usually they can be controlled by increasing the vigor of the tree by means of fertilizers, proper drainage or scale control. Frequently a heavy application of nitrogenous fertilizer corrects the trouble because the grubs generally do not thrive on fast-growing wood.

The P.D.B.-oil treatment described for the lesser peach borer is also moderately effective in controlling bark beetles.

(For a full description of these borers and their control, together with a discussion of certain substitutes for P.D.B., see Illinois Natural History Survey Circular 31.)

Catfacing

The injury to the surface of peaches and apricots known as *catfacing* is caused by tarnished plant bugs, various species of stink bugs, and the plum curculio. DDT has proved effective against plant bugs and stink bugs and is now included as a general recommendation in the spray and dust schedules. A grower can now feel some safety when he grows legumes in his orchard as a part of his soil-management program, even tho they attract more catfacing insects than nonlegume crops.

Except for poisoning the curculios, applications of other insecticides have not reduced catfacing.

Virus Diseases of Peaches

Peach yellows, peach rosette, phony peach, and yellow-red virosis are virus diseases of peaches known to have been present in Illinois during the past ten years.

Peach yellows is often harbored in the plum, where the symptoms are inconspicuous. For this reason wild plums in the neighborhood of peach orchards should be eradicated. The yellow-red virosis is primarily a disease of chokecherry, but peach trees in the neighborhood of infected chokecherries may become infected. All chokecherries within half a mile of peach orchards should be destroyed. Common wild black cherry does not carry this virus.

If virus diseases are suspected, write the STATE NURSERY INSPECTION SERVICE, Glen Ellyn, Illinois, for an inspection.

PEACHES AND APRICOTS: STANDARD SPRAY SCHEDULE

Application and purpose	Time to apply	Materials in 100 gallons of water
Dormant — for San Jose scale	In spring before buds swell	Dormant oil, 2 to 3 gal.
— for leaf curl (<i>not on apricots</i>); omit after standard summer treatment	.....	Copper sulfate, 4 lb. Hydrated lime, 3 lb. — or — Liquid lime sulfur, 5 gal.
— for San Jose scale and leaf curl	.....	Copper sulfate, 4 lb. Hydrated lime, 3 lb. Dormant oil, 2 to 3 gal.
Prebloom , for brown rot blossom blight	When buds show pink	Liquid lime sulfur, 1½ gal.
Bloom , for brown rot blossom blight and catfacing insects	Early to full bloom	DDT, 1 lb. actual Microfine sulfur, 8 lb.
1st cover , for curculio and catfacing insects, and brown rot blossom blight	When shucks are halfway off	DDT, 1 lb. actual Microfine sulfur, 6 lb. — plus either — Lead arsenate, 3 lb. Zinc sulfate (55%), 2 lb. Hydrated lime, 3 lb. — or — Basic lead arsenate, 4½ lb. Hydrated lime, 4½ lb.
2d cover , for curculio and scab	10 days after 1st cover	Same as 1st cover but omit DDT
Arsenical corrective , to prevent arsenical injury	10 days after 2d cover	Zinc sulfate, 2 lb. Hydrated lime, 3 lb. — or — Hydrated lime, 6 lb.
3d cover , for curculio and scab	2 to 3 weeks after 2d cover	Same as 1st cover but omit DDT
Arsenical corrective , to prevent arsenical injury	10 days after 3d cover	Same as for above corrective spray
4th cover , for curculio and brown rot	About 1 month before harvest	Same as 1st cover but omit DDT
5th cover , for brown rot and oriental fruit moth	About 15 days before harvest	DDT, 1 lb. actual Microfine sulfur, 8 lb.
6th cover , for brown rot	7 days before harvest	Same materials as for 5th cover

DUST SCHEDULE FOR PEACHES AND APRICOTS

(This schedule is based on applications of $\frac{1}{3}$ to $\frac{1}{2}$ pound of dust per mature tree, applied when foliage is dry and from one side only at each application.)

Application and purpose	Time to apply	Dust formulas
Dormant , for San Jose scale and leaf curl	(See spray schedule)	(See spray schedule)
Prebloom , for brown rot blossom blight	(See spray schedule)	(See spray schedule)
Bloom , for blossom blight and catfacing insects	Early to full bloom	DDT, 5 lb. actual Sulfur, 60 lb. Lime, 15 lb. Talc, 15 lb. Oil, 5 lb.
1st cover , for curculio and catfacing insects	When shucks are cracking	DDT, 5 lb. actual Sulfur, 50 lb. Lead arsenate, 10 lb.* Lime, 15 lb. Talc, 15 lb. Oil, 5 lb.
2d cover , for curculio	When shucks are $\frac{2}{3}$ off	Same as 1st cover but omit DDT
3d cover , for curculio and scab	10 days after 2d cover	Same as 2d cover
4th, 5th, and 6th covers , for curculio and scab	At 10-day intervals after 3d cover	Same as 2d cover
7th cover , for curculio, 2d brood	One month before harvest	Same as 2d cover
8th cover , for curculio	7 days after 7th cover	Same as 2d cover
9th, 10th, and 11th covers , for brown rot and oriental fruit moth	At 5-day intervals after 8th cover	Same as bloom dust

* If basic lead arsenate is used in the formula for first cover, increase to 15 pounds.

CHLORDANE AND BENZENE HEXACHLORIDE

Because chlordane and benzene hexachloride gave such excellent control of plum curculio on peaches and apricots in 1947 their use is suggested for 1948 spray and dust schedules. (By comparison, lead arsenate gave poor control and injured the foliage and fruit.

Some undesirable results may, however, accompany the use of these two materials, so a grower who decides to use them should use them on only a part of the orchard. A full schedule applied to a small area appears to give more satisfaction than one or two applications over the entire orchard.

SUGGESTED SPRAY SCHEDULE FOR PEACHES AND APRICOTS USING CHLORDANE AND BENZENE HEXACHLORIDE

(For dormant, prebloom, and bloom applications see standard schedule, page 20.)

Application and purpose	Time to apply	Materials in 100 gallons of water
1st cover , for curculio, catfacing insects and blossom blight	When shucks are halfway off	Microfine sulfur, 6 lb. — plus either — Chlordane (<i>see page 34</i>) 1 lb. actual ^a — or benzene hexachloride ^b (12% gamma) 1½ lb. actual (<i>see page 34</i>)
2d cover , for curculio and scab	7 to 10 days after 1st cover	Same as 1st cover
3d cover , for curculio and scab	7 to 10 days after 2d cover	Same as 1st cover
4th cover , if curculio is abundant	7 to 10 days after 3d cover	Same as 1st cover
5th cover , if curculio is abundant	7 to 14 days after 4th cover	Same as 1st cover
6th cover , for curculio and brown rot	One month before harvest	Microfine sulfur, 6 lb. Chlordane, 1 lb. actual (<i>see footnote c</i>)
7th cover , for oriental fruit moth and brown rot	15 days before harvest	Microfine sulfur, 8 lb. DDT, 1 lb. actual
8th cover , for brown rot	7 days before harvest	Same as 7th cover

^a Chlordane is produced commercially in two different forms. One form is a water-miscible liquid containing 40 percent active ingredient; thus 1 quart is the equivalent of about 1 pound of actual chlordane. The second form is a 50-percent wettable powder; thus 2 pounds are the equivalent of 1 pound of chlordane.

^b Benzene hexachloride containing 10 to 12 percent gamma isomer is available commercially as a 50-percent wettable powder containing 5 to 6 percent gamma isomer; thus 3 pounds are required in 100 gallons of water to meet the specifications in the schedule.

^c If preferred, use same materials as for first cover in standard spray schedule, page 20, but omit DDT.

Since benzene hexachloride may give an undesirable flavor to the fruit, it should be used only in early sprays or dusts. Chlordane does not flavor the fruit, and can therefore be used without caution in this respect. But since it has not been tested so extensively as benzene hexachloride it is not as generally suggested in the schedules this year.

Both these materials are still in the experimental stage and should be used accordingly.

SUGGESTED DUST SCHEDULE FOR PEACHES AND APRICOTS USING CHLORDANE AND BENZENE HEXACHLORIDE

(For dormant, prebloom, and bloom applications see standard schedule, page 20.)

Application and purpose	Time to apply	Dust formulas ^a
1st cover, for curculio and brown rot blossom blight	When shucks are breaking	Benzene hexachloride, 1% gamma Sulfur, 50% Oil, 5% Inert ingredients, 44%
2d cover, for curculio	When shucks are $\frac{2}{3}$ off	Same as 1st cover
3d cover, for curculio and scab	7 to 10 days after 2d cover	Same as 1st cover
4th cover, for curculio and scab	7 to 10 days after 3d cover if curculios are abundant	Same as 1st cover
5th cover, for curculio	7 to 10 days after 4th cover if curculios are abundant	Same as 1st cover
6th cover, for curculio	7 to 10 days after 5th cover if curculios are abundant	Same as 1st cover
7th cover, for curculio and brown rot	One month before harvest	Chlordane, 5% Sulfur, 50% Inert ingredients, 45% (see footnote b)
8th, 9th, 10th, and 11th covers, for oriental fruit moth and brown rot	At 5-day intervals after 7th cover until harvest	Same as standard schedule

^a These formulas are based on 1947 experiments. Use chlordane and benzene hexachloride in percentages indicated. Quantities of other ingredients may vary.

^b If preferred, use same materials as for first cover in standard dust schedule, page 21, but omit DDT.

PLUMS

Plums are subject to only two virus diseases, *rosette* and *yellow*s. The only way to control these diseases is to remove all infected trees promptly.

Black knot, a fungus disease, may be controlled by removing and burning, for two successive years, all twigs showing knots during the winter months. On large limbs the knots may be cut out, thus saving the limbs. Spraying is sometimes helpful. A delayed dormant spray made of copper sulfate 12 pounds, hydrated lime 12 pounds, and "Dendrol" dormant oil 2 gallons, for each 100 gallons of water should be applied as buds begin to swell. On infected trees follow this delayed dormant spray with liquid lime sulfur, using 2 gallons in 100 gallons of water for the first and second cover sprays (this will take the place of the recommended copper sulfate - hydrated lime spray).

SPRAY SCHEDULE FOR PLUMS

Application and purpose	Time to apply	Materials in 100 gallons of water
Dormant, for scale insects	Before buds begin to open	Dormant oil, 2 gal.
1st cover, for curculio	Right after shucks have fallen	Lead arsenate, 3 lb. Copper sulfate, 1 lb. Hydrated lime, 2 lb. Summer oil, 1 qt.
2d cover, for curculio	10 days after 1st cover	Same as for 1st cover
Additional covers		
— for brown rot.....	At weekly intervals starting 3 weeks before harvest	Microfine wettable sulfur, 8 lb.
— for aphids.....	Apply when needed	Soap flakes, 4 lb. Nicotine sulfate (40%), 1 pt.

For borer control see page 18, peach borer.

SPRAY SCHEDULE FOR CHERRIES

Application and purpose	Time to apply	Materials in 100 gallons of water
Dormant, for Forbes scale	Before buds begin to open	Dormant oil, 2 gal.
Ground spray, for leaf spot	In early spring before buds begin to open. Apply to ground only. Use 500 gal. per acre	"Elgetol," $\frac{1}{2}$ gal.
1st cover, for brown rot, leaf spot, curculio, and slug	Right after shucks have fallen	Lead arsenate, 3 lb. "Fermate," $1\frac{1}{2}$ lb. Soybean flour, $\frac{1}{4}$ lb.
2d cover, for same pests as 1st cover	10 days after 1st cover	Same as 1st cover
Additional sprays		
— for leaf spot.....	Right after harvest	"Fermate," $1\frac{1}{2}$ lb.
— for cherry slugs.....	In August.....	Lead arsenate, 2 lb. Hydrated lime, 6 lb.

Thoro Spraying Is Essential For All Fruits

Use adequate pressure. Do not rely on measurements of pressure gages after two or more seasons of service — have the gages checked.

Select disks with correct openings and replace worn disks. Be sure the disks will carry the maximum load. A 35-gallon pump should discharge at least 30 gallons a minute during full operation.

Spray tops of trees with special care. Equip the spray rig with a tower. Apply top-off sprays when recommended.

Examine fruit and leaves frequently. Look for evidence of disease and insect injury. See whether spray coverage is complete, especially in tops of trees.

Apply enough spray. And remember that one good spray is worth more than two poor ones.

BRAMBLES

Sanitation

Certain diseases of brambles such as *crown gall*, *orange rust*, *mosaic*, *leaf curl*, and *bramble streak* cannot be controlled by spraying. The following practices are recommended to aid in preventing these diseases:

(1) Do not replant on a site where diseased plants have been recently grown. (2) Select resistant varieties. (3) Order planting stock from a reliable nursery. (4) Have plantings of red and black raspberries as much as 300 feet apart. (5) As soon as diseased plants are detected, dig them up with as many of their roots as possible, and burn at once. (6) At planting time cut off old stubs of 2-year-old nursery stock and "handles" of young purple and black raspberries. (7) Remove and burn old fruiting canes immediately after harvest.

(For a full discussion of selection of varieties and cultural methods, see Illinois Circular 508, *Bramble Fruits*.)

SPRAY SCHEDULE FOR BRAMBLES

Application and purpose	Time to apply	Materials in 100 gallons of water
Delayed dormant , for anthracnose, rose scale, and possibly red spider	In spring after beginning of growth but not after leaflets are $\frac{3}{8}$ inch long	Copper sulfate, 8 lb. Hydrated lime, 8 lb. Dormant oil, 2 gal. — or — Commercial liquid lime sulfur, 12 gal.
Prebloom , for anthracnose, and possibly fruitworm	1 week before bloom or when bloom buds are well enlarged	Copper sulfate, 8 lb. Hydrated lime, 8 lb. Lead arsenate, 2 lb. Summer oil, 1 gal.
Additional sprays — for sawflies.....	Within 1 week after full foliage	Lead arsenate, 2 lb.
— for red spider and other mites, leaf spots, and anthracnose	2 sprays at intervals of 2 to 3 weeks after harvest	Copper sulfate, 4 lb. Hydrated lime, 4 lb. Summer oil, 1 gal.

CURRANTS, GOOSEBERRIES, GRAPES

SPRAY SCHEDULE FOR CURRANTS AND GOOSEBERRIES

Application and purpose	Time to apply	Materials in 100 gallons of water
Dormant , for scale insects	Before growth starts	Dormant oil, 2 gal.
1st cover , for currant aphids and leaf spot	When leaves start to unfold	Copper sulfate, 4 lb. Hydrated lime, 6 lb. Nicotine sulfate (40%), 1 pt.
2d cover , for currant worm and leaf spot	When in full foliage; do not wait for worms to appear	Copper sulfate, 4 lb. Hydrated lime, 6 lb. Lead arsenate, 2 lb.
Additional covers — for leaf spot.....	2 sprays 2 weeks apart, following 2d cover	Same as 2d cover except omit lead arsenate
— for worms feeding on plants in fruit.....	As needed	Rotenone garden dust or spray (rotenone is not poisonous to man)

SPRAY SCHEDULE FOR GRAPES^a

Application and purpose	Time to apply	Materials in 100 gallons of water
Dormant , for scale and anthracnose	Before buds open (<i>seldom needed</i>)	Commercial liquid lime sulfur, 7 gal.
1st cover , for black rot and grape flea beetle	When new growth is 2 to 4 inches long	DDT, 1 lb. actual "Fermate," 1½ lb. Soybean flour, ¼ lb.
2d cover , for grape berry moth, rose chafer, black rot, and anthracnose	Just before the bloom	DDT, 1½ lb. actual "Fermate," 1½ lb. Soybean flour, ¼ lb.
3d cover , for grape leafhopper, grape leaf folder, grape root worm, rose chafer, black rot, anthracnose, and downy mildew	After bloom, when berries are set	Same as 2d cover
4th cover , ^b for leafhopper, black rot, anthracnose, ripe rot, mildews	3 weeks after 3d cover	Same as 2d cover

^a This schedule is based on the supposition that each application will use approximately 250 gallons of spray per acre.

^b Later applications of DDT and "Fermate" may be advisable, depending on the season. These sprays have not been recommended because of lack of knowledge concerning the residual problems which might arise.

STRAWBERRIES

Sanitation

Diseases and insects of strawberries can usually be controlled by cultural and sanitary methods. The following practices are recommended:

(1) To avoid white grubs, do not plant strawberries on sod-land until it has been under cultivation for at least two years. (2) To reduce crown borer injury, separate new beds at least 350 yards from old beds and plow up the patch after two picking seasons. (3) Choose varieties resistant to disease in so far as possible. For example, in areas where red stele root rot is common, plant varieties resistant to this disease. (4) Renovate beds immediately after each harvest.

(For a full discussion of cultural and sanitation methods for strawberries, see Illinois Circular 463, Strawberry Culture in Illinois.)

SPRAY SCHEDULE FOR STRAWBERRIES

Application and purpose	Time to apply	Materials in 100 gallons of water
1st cover, for leaf spot and leaf roller	First appearance of blossoms	Copper sulfate, 4 lb. Hydrated lime, 6 lb. Lead arsenate, 3 lb.
2d cover, for leaf spot and leaf roller	Immediately after blossoming	Same as for 1st cover
Additional covers, for leaf roller on plants with fruit	As needed	Rotenone garden dust or spray (<i>rotenone is not poisonous to man</i>)

PART II: RODENT CONTROL¹

Rodents take a heavy toll in killed and damaged trees each year. Definite programs should be adopted for control of these pests as for insects and diseases.

MICE

Mice do most of their damage to orchards in the dormant season. *Meadow mice*, *pine mice*, and *lemming mice* (Fig. 9) are found in Illinois. The *meadow mouse* is the most common. It has coarse, shaggy fur and can be distinguished by its tail, which is about twice as long as its hind foot measured from the hock to the tip of the toes. It feeds and lives largely above ground and has surface runways beneath the ground cover. In contrast, the *pine mouse* has compact, silky-fine, reddish-brown fur and lives and feeds largely below the surface of the ground. Its tail is barely longer than its hind foot. The *lemming mouse* looks somewhat like the meadow mouse but its tail is no longer than its hind foot. Its habits are practically the same as those of the meadow mouse.

A survey should be made each fall to determine whether mice are present. This can be done by walking up and down the tree

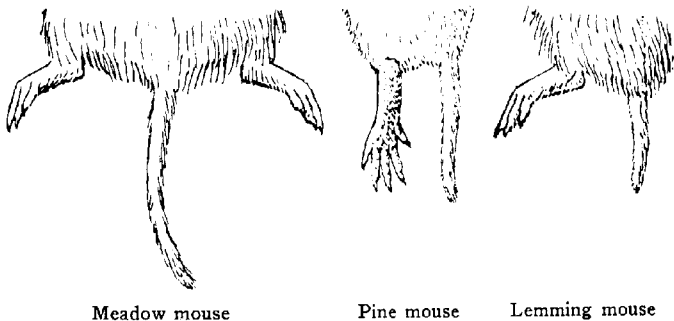


Fig. 9.—These are the mice that damage Illinois orchards. They are easy to distinguish by length of tail and other differences (see text above).

¹ These recommendations are adapted for the most part from material furnished by G. C. ODERKIRK, Division of Predator and Rodent Control, U. S. Department of the Interior, West Lafayette, Indiana.

rows, watching for mouse runways underneath the grass or mulch on top of the ground, and noting whether there are any small openings extending to runways underneath the soil surface. If there is evidence of mice, prepare for baiting.

Zinc phosphide is a very effective poison against all three mice just mentioned. Strychnine is not so effective for the pine mouse but will take care of the other two.

Zinc Phosphide Apple Bait

• **Preparation.** Select small ripe apples about $1\frac{1}{2}$ to 2 inches in diameter. Cut each apple in half and then slice each half into four equal pieces. If the pieces are cut smaller, mice may carry them away to store instead of eating them, thus making the bait ineffective. Do not peel or core. Place 3 to 5 quarts of the cut bait in a clean, dry metal pail or can. Measure *one level teaspoonful* of the zinc phosphide *for each quart of cut bait*. Dust this over the sliced apples and stir or shake until the bait is uniformly coated with the poison. It is then ready to use. One quart of bait will treat $\frac{1}{3}$ to 1 acre of orchard, depending on the degree of infestation. Prepare fresh bait daily.

• **Application.** Distribute bait systematically and thoroly row by row. Use an ice pick or pointed stiff wire to place the bait. Mice require protective cover and seldom leave their trails under matted grass or other cover. For this reason bait containers of tile, glass, metal, or wood are no longer recommended.

Baits should be placed only in surface runways, mole burrows, and holes. Examine the cover crop for runways at about 12-foot intervals. Circle each tree and find the runways beneath the drip area. Where runways are found, 3 to 4 placements within the area should suffice. One apple slice at each baiting spot is enough. Place grass lightly over the bait. Mice commonly inhabit mole burrows. To avoid collapsing these burrows, put bait thru a hole in the side rather than thru the top.

If trees are mulched, raise the mulch, place the bait in the runways beneath, and let the mulch down again. Fencerows, low unplanted areas, spots where trees are missing, as well as adjoining fields of clover or alfalfa, should be baited.

•**Timing.** The best time to bait an orchard is after harvest, when cool weather has caused mice to complete their migration. This will vary from mid-October thru mid-November. Mice are most active from the late forenoon until midafternoon; hence baiting is best done in the forenoon. Avoid very windy days, rainy days, or very cold days.

•**Precautions.** Entrust preparation of bait only to reliable persons. Wash the hands and all utensils after mixing the bait, and at the end of the day wash all utensils in which bait was handled in the orchard. **DO NOT HANDLE POISONED BAIT WITH BARE HANDS.** Use only zinc phosphide taken from airtight containers, as it loses its potency when exposed to air. It is important to follow directions carefully.

Strychnine-Treated Grain Bait

Strychnine-treated grain bait may be purchased already mixed from reliable dealers. Place a heaping teaspoonful of it at each bait location in surface runways, holes, or mole runways. It is worth the added trouble to put out both grain and apple bait so that the mice will have a choice.

RABBITS

During the winter, especially when snow is on the ground and food is scarce, rabbits feed on the tender bark of many kinds of young fruit trees. Protection may be secured by using mechanical barriers, chemical repellents, or baits.

Mechanical Barriers

Mesh wire will keep rabbits from the trunks of young trees as long as necessary, or the trees may be wrapped each fall with paper of various kinds (Fig. 10). Vencer bands will also protect the trunks.

During deep snows the bases of the framework branches will need protection, since rabbits travel on top of the snow. Cotton-tail rabbits can reach about 2 feet.

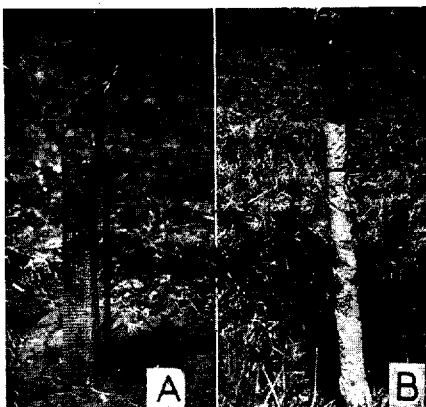


Fig. 10.—Failure to protect young trees from rodents and insects, even for one season, may result in their complete loss. Galvanized gravel screen, 4 meshes per inch, placed around the trunk (A) offers protection against rodents. Wrapping paper tied around the trunk with twine (B) protects against both rodents and wood-boring insects.

Chemical Repellents

The use of chemical repellents is considered the least effective method for rabbit control. However, two formulas are given here for growers who may wish to use repellents.

FORMULA 1

This formula is a mixture of rosin and asphalt emulsion dissolved in ethylene dichloride, to which copper sulfate, copper carbonate, and dry lime sulfur are added. It may be purchased ready-mixed from the DISTRICT AGENT, DIVISION OF PREDATOR and RODENT CONTROL, U. S. DEPARTMENT OF INTERIOR, West Lafayette, Indiana.

Application may be made either as a paint or as a spray. As a paint, apply with a cheap paintbrush without dilution but after thoro stirring. As a spray, dilute each quart of the paint mixture with two quarts of ethylene dichloride.

FORMULA 2

This is a mixture of rosin and alcohol which the Michigan Agricultural Experiment Station has found effective.

• **Preparation.** Dissolve 7 pounds of rosin in 1 gallon of ethyl (grain) alcohol. The dark-colored cheaper grade of rosin and denatured commercial ethyl alcohol are satisfactory. Methyl (wood) alcohol is not recommended. A good method of mixing is to pulverize the rosin and add it to the alcohol in a container with a cover tight enough to allow shaking and prevent evaporation. Keeping the container in a warm room and shaking it occasionally helps to get the rosin into solution. NO HEAT SHOULD BE APPLIED. The rosin usually dissolves in 24 hours.

• **Application.** Apply the repellent with a cheap paintbrush in the fall and only when the bark is dry. One application will protect the trees all winter. Water causes a white precipitate to form in the solution. This changes its consistency and interferes with application. To avoid contaminating the solution with water, use a small container in the orchard and do not pour any of the solution from this can back into the reserve stock. Treated trees always turn white the first time it rains or snows, but this does not change the effectiveness of the repellent.

Since cottontail rabbits can reach about 2 feet above the surface of the snow, the trunks and the scaffold branches of low-headed trees should be painted 2 feet higher than the snow is expected to drift.¹ The amount of repellent required will, of course, depend upon the height of treatment and size of tree. One gallon will treat 150 to 200 two-year-old trees.

Baits

The use of poison bait for the control of rabbits is illegal in Illinois, unless permission has been secured from the STATE DEPARTMENT OF CONSERVATION, Springfield, Illinois.

If the rabbit problem is severe enough, and permission to bait has been obtained, use strychnine-treated oats designed for mouse control or prepare the following bait:

Moisten with water 20 pounds of alfalfa leaves. Dust 1 ounce of powdered strychnine over the leaves and stir them well. Place the bait (either grain or alfalfa leaves) under boxes with openings at each end large enough for a rabbit to enter. Cover the boxes with brush or straw.

¹ The rosin-alcohol repellent has not proved effective against the meadow mouse.

PART III

NOTES ON SPRAY MATERIALS

Benzene hexachloride. Mainly of interest for control of plum curculio on peach—proved about equal to chlordane and much better than lead arsenate in 1947 tests. Is effective for only short time after applied, but has given excellent control when used as outlined in spray and dust schedules in this circular. If too much is used, or it is used too late in season, it may give a musty flavor to fruit. Should therefore be used for only first brood of curculio on peach.

Will probably be used most commonly as a dust because frequent applications are needed and dust is cheaper. Also dust is less likely to give disagreeable flavor to fruit.

No injury to fruit or foliage from this chemical has been observed.

"Bioquin." Not yet tested enough to be recommended as agricultural fungicide. May prove useful in destroying apple scab and cherry leaf spot when applied to dead leaves in early spring.

"Bioquin 1" (copper salt of "Bioquin") is one of most promising organic materials for control of fungus diseases. Highly effective against apple scab, blotch, and bitter rot. Appears excellent for grape black rot and anthracnose. May be used alone or in combination with sulfur. Can be used with all common spray materials except nicotine, which appears less effective when used with it. Has not yet caused spray injury under Illinois conditions, but some workers feel it is safer to use in combination with lime. Not generally available to Illinois growers in 1948 because of manufacturing difficulties; also it is expensive.

Bordeaux mixture. Made of copper sulfate (blue vitriol or bluestone), hydrated lime, and water. Copper sulfate can be bought as crystals, granules, or powder. All forms have same composition. *Indicate desired form when ordering.* Because of its convenience, growers like powder form. Crystals require several hours to dissolve. When possible, get hydrated lime from firms manufacturing a special spray lime. Do not keep lime from one season to another.

Formulas are indicated by numbers: $\frac{1}{2}$ -1-100 means mixture contains $\frac{1}{2}$ pound copper sulfate, 1 pound hydrated lime, and 100 gallons water.

Most growers use instant method of mixing bordeaux, thus: Slowly sift copper sulfate into tank as it is being filled with water and the agitators are running. After adding $\frac{2}{3}$ of water and *all the copper sulfate*, sift in lime while adding rest of water. *Always* add copper sulfate *before* lime.

If bordeaux mixture is to be used with oil, add the oil just before the tank is completely filled. Always add the oil *last*.

Chlordane. One of most promising of new insecticides. Marketed as a water-miscible liquid, wettable powder, and dust under various trade names. Has wide variety of uses but of most interest to fruit growers for grasshoppers (*see page 6*) and plum curculio.

One season's tests in Illinois and other states show chlordane to be much superior to lead arsenate for plum curculio on peaches. No objectionable features in its use have yet been observed. Most 1947 tests were made with spray. Limited use is suggested for the dust until more tests are made.

DDT. Now commonly included in spray schedules for late apples in central and southern Illinois. One of most effective materials ever found for codling moth and leafhoppers. DDT schedule therefore given equal rank this year with standard lead arsenate and nicotine schedule.

Certain drawbacks to DDT must be recognized. Increase in mites and red banded leaf roller where it is used is well known. Other hazards may develop. Some growers feel they get better apples without DDT.

General use of DDT is not recommended in northern Illinois, where codling moth is not usually a serious problem. For same reason it is not suggested for summer apples.

In spray schedule for grapes DDT is included for first time, replacing lead arsenate and nicotine. Tests show it to be as good, frequently better, for control of berry moth. Excellent for leafhoppers. No drawback observed to its use on grapes.

DDT is included for first time in Illinois peach schedules, spray and dust. Apply *early in season* for catfacing insects, and *late* (when twigs have hardened) for oriental fruit moth. Do not use thruout season on peaches because it may harm natural enemies of oriental fruit moth and mites.

Dinitro-o-cresol. Marketed under many brands as wettable powders and solutions. "Elgetol" is a 23-percent solution of sodium dinitro-o-cresylate. Same chemical is also sold as "Kreenite." Both appear equally efficient. Either may be used in dormant sprays for oystershell scale, scurfy scale, aphids, or as ground spray for apple scab or cherry leaf spot. Has been used also for thinning apple blossoms.

Wettable powders are used mostly with dormant oil sprays. They are very effective against oystershell and scurfy scale and aphids.

Do not use dinitro-o-cresol compounds except in strictly dormant period. Do not use on peaches at any time.

"DN 111." A wettable powder, very effective for mites on apples; somewhat more toxic to two-spotted mite than European red mite. In 100 gallons of water $\frac{3}{4}$ pound gives satisfactory control and is not so likely to injure fruit or foliage as $1\frac{1}{4}$ pounds recommended by manufacturer. If used when temperature is above 90° F. may injure fruit or foliage. Also causes injury when used with oil sprays. For control of mites spray inside of tree thoroly.

"Fermate." A commercial compound, also marketed under trade name "Karbam." May be used in apple schedule for apple scab, blotch, and cedar rust. May be substituted for or used with sulfur. May be substituted for bordeaux mixture or hydrated lime but must NOT be used in combination with either. Do not use before or after a bordeaux spray — may injure fruit and foliage.

Nicotine. Sold mostly as nicotine sulfate and "fixed" nicotine. *Nicotine sulfate* is primarily a contact insecticide. May be combined with many other sprays. *Fixed nicotines* are combinations of nicotine and other materials such as bentonite, oil, and DDT. Designed mostly for stomach poisons, as nicotine stays in spray residue for comparatively long time.

Oil sprays. *Summer oils* are made from highly refined white oils and an emulsifying agent. Mineral oils used on foliage should be paraffin type from a straight distillation run, not blended to meet sulfonation or viscosity speci-

fications. Unsulfonated residue should be 85 percent or above, with a viscosity of 55 to 83 seconds, 100° F., Saybolt test. *Miscible oils* are concentrated emulsions, contain little or no water, and do not freeze.

Parathion. Marketed under trade name "Thiophos 3422" as a wettable powder. Has received considerable publicity because of excellent control of codling moth and mites in experimental tests. Under no circumstances, however, should parathion be used until more thoroly tested in field. Known to be toxic to spray operator and may leave a poisonous residue on fruit at harvest.

"Phygon." A wettable powder. Has given excellent control of apple scab but likely to cause injury under some conditions. Purpose is largely to *protect against* disease — should not be expected to destroy an infection already started. Not recommended at present under Illinois conditions — may burn operator and may injure fruit. If included in the spray schedule, it should not be used when temperatures are above 90° F.

"Puratized Agricultural Spray." Has given excellent control of apple scab in Illinois tests but not very dependable results in some neighboring states. Therefore not generally included in Illinois recommendations. If used, apply mainly to kill scab when other fungicides have failed. Contains mercury; therefore use only in early sprays. Do not use with hydrated lime, sulfur, or oil sprays.

Causes serious damage to fruit and foliage of peaches. Does not hurt apples. Spray operators should avoid contact with the concentrated material.

Sulfurs. Can be bought as liquid or dry lime sulfur, flotation sulfur pastes, microfine wettable sulfurs, ground wettable sulfurs, and fused and ground sulfur and bentonite.

Dry lime sulfur is more expensive than liquid but more convenient. Both forms are very efficient but more likely to cause injury than other sulfur fungicides. Next to lime sulfur, flotation sulfur pastes are the most efficient sulfur fungicides. Have particle size of 1/25000 to 1/2500 inch. Not convenient to handle, but their mildness and efficiency offset their bulkiness.

Microfine wettable sulfurs are highly efficient. Have average particle size of 1/2500 inch. (*Microfine* commonly means dry sulfurs that have been especially treated to break them into small particles and make them wettable in water.)

Select brands with care — fineness of particle is very important.

Tetraethyl pyrophosphate. An old organic compound new to agriculture. Expected to largely replace hexaethyl tetraphosphate for mite control in 1948. Also excellent for aphids if applied before leaves curl. Toxicity drops fairly fast after compound is diluted in spray tank. May harm some parts of spray machinery.

Use greatest caution when spraying with this material. Very poisonous to man and to warm-blooded animals whether they eat it or absorb it thru skin. Because of this hazard it is not included in Illinois apple schedules. One application is included for pears because of excellent control of pear psylla in 1947 tests. Reported to injure peaches.

Weekly Report on Orchard Insects and Diseases By Radio and Mail

Each Monday noon during the entire season, the Illinois Farm Hour will broadcast information on the control of orchard insects and diseases. This program originates at W-I-L-L, the University of Illinois Radio Station, 580 on your dial. Other stations that will probably give similar service on their farm programs during 1948 are:

WCMJ	Ashland, Ky.	WFBM	Indianapolis, Ind.
WIBC	Bloomington, Ill.	WIRE	Indianapolis, Ind.
KFVS	Cape Girardeau, Mo.	WISH	Indianapolis, Ind.
WCIL	Carbondale, Ill.	WHB	Kansas City, Mo.
WCNT	Centralia, Ill.	WKMO	Kokomo, Ind.
WAAF	Chicago, Ill.	WBAA	Lafayette, Ind.
WBBM	Chicago, Ill.	WGRC	Louisville, Ky.
WGN	Chicago, Ill.	WHAS	Louisville, Ky.
WLS	Chicago, Ill.	WINN	Louisville, Ky.
WMAQ	Chicago, Ill.	WCRG	New Albany, Ind.
WDWS	Champaign, Ill.	WQUA	Moline, Ill.
WCKY	Cincinnati, O.	WPAD	Paducah, Ky.
WLV	Cincinnati, O.	WSIV	Pekin, Ill.
WBNS	Columbus, O.	WMBD	Peoria, Ill.
WDAN	Danville, Ill.	WMMJ	Peoria, Ill.
WHIO	Dayton, O.	WTAD	Quincy, Ill.
WTRC	Elkhart, Ind.	VTAX	Springfield, Ill.
WOWO	Ft. Wayne, Ind.	KFUO	St. Louis, Mo.
WGIL	Galesburg, Ill.	KMOX	St. Louis, Mo.
KHMO	Hannibal, Mo.	KXOK	St. Louis, Mo.
WEBQ	Harrisburg, Ill.	WEW	St. Louis, Mo.
WSON	Henderson, Ky.	WROW	Terre Haute, Ind.
WGPF	Herrin, Ill.	WDZ	Tuscola, Ill.
WHOP	Hopkinsville, Ky.		

Consult your local station or get in touch with your farm adviser or the Illinois Agricultural Experiment Station, Urbana, Illinois, for the 1948 list.

Mimeographed copies of this information (*The Spray Service Report*) will be sent to Illinois orchardists under free mailing privilege at no cost to them. Anyone wishing to receive these weekly releases by faster mail may have them by sending 75 cents to pay for third-class mailing, or by sending \$1.00 for first-class mailing. (Either stamps or checks payable to the University of Illinois are acceptable.) Out-of-state growers will be furnished this information under postage at the above rates if the total number of requests is not too large.

These weekly reports are prepared by the agricultural experiment stations of Indiana, Kentucky, and Illinois, the Kentucky State Horticultural Society, the Federal Deciduous Fruit Insect Laboratory at Vincennes, Indiana, and the Illinois State Natural History Survey.

(Orchardists will find this kind of spray record very useful.)

RECORD OF MY APPLE SPRAY SCHEDULE 194__

SPRAY	Started (date)	Finished (date)	Total gals. or tanks	Materials used or other remarks
Dormant				
Prepink				
Pink				
Bloom				
Calyx				
Calyx top-off				
COVER				
First				
Second				
Third				
Fourth				
Fifth				
Sixth				
Sixth top-off				
SECOND BROOD				
First				
Second				
Third				
Fourth				

RECORD OF MY PEACH SPRAY OR DUST SCHEDULE 194__

SPRAY or DUST	Started (date)	Finished (date)	Wind direc- tion	Amount of material used	Materials used or other remarks
Dormant					
Bloom					
COVER					
First					
Second					
Third					
Fourth					
Fifth					
Sixth					
Seventh					
Eighth					
Ninth					
Tenth					
Eleventh					

KEY FOR IDENTIFYING NEWER ORGANIC MATERIALS FOR CONTROL OF INSECTS, DISEASES, AND WEEDS

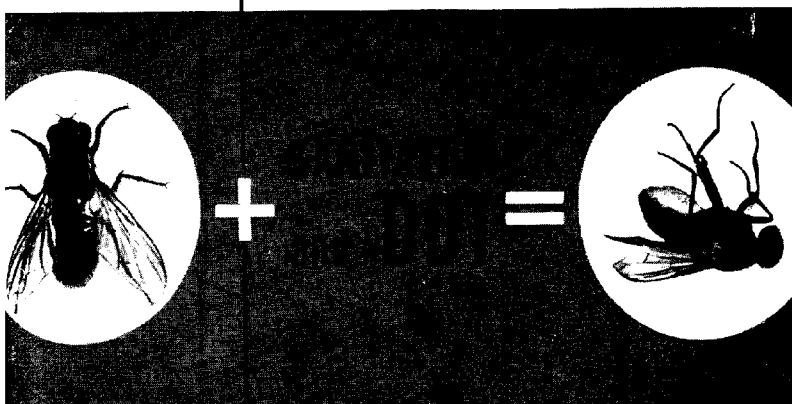
Chemical	Common name, brand name, or abbreviation ^a	Use
Ammonium sulfamate.....	"Amate".....	Weed killer
Benzene hexachloride.....	BHC, HCCH.....	Curculio
1,2,4,5,6,7,8,8-octachloro-4,7- methano-3a,4,7,7a-tetrahydroin- dane.....	Chlordane.....	Curculio, grasshoppers
Copper 8-quinolinolate.....	"Bioquin 1," Copper 8.....	Scab (apple) Blotch Bitter rot
2,3-dichloro-1,4-naphthoquinone.....	"Phygon".....	Apple scab
2,4-dichlorophenoxyacetic acid.....	2,4-D.....	Weed killer
Dichlorodiphenyltrichloroethane.....	DDT.....	Codling moth, leaf hop- per, catfacing pests
Dichlorodiphenyldichloroethane.....	DDD.....	None on fruit
1,2-dichloropropane and 1,3-dichloropropylene.....	DD.....	Soil fumigant
Dicyclohexylamine salt of 2,4-dinitro-o-cyclohexylphenol.....	"DN 111".....	Mites
Dinitro-o-cresol.....	Dinitro, DNC, DNOC.....	Scale insects, aphids on apple
Ferric dimethyldithiocarbamate.....	"Fermate," "Karbam Black," FDDC.....	Apple scab, blotch, cedar rust
Heptadecyl glyoxalidine.....	"Compound 341".....	Apple scab and cherry leaf spot
Hexaethyl tetraphosphate.....	HETP.....	Mites
o-diethyl-p-nitrophenyl thionophosphate.....	Parathion "Thiophos 3422".....	Mites
Para-dichlorobenzene.....	PDB.....	Borers
Phenylmercuric triethanol ammonium lactate.....	"Puratized Agricultural Spray".....	Apple scab
Sodium dinitro-o-cresylate.....	"Elgetol," "Kreenite".....	Scale insects, aphids
Tetraethyl pyrophosphate.....	TEP.....	Mites, pear psylla
Zinc ethylene-bis- dithiocarbamate.....	"Dithane Z 78," "Parzate".....	Vegetable diseases
Zinc dimethyldithiocarbamate.....	"Zerlate," "Methasan," "Karbam White," ZDDC.....	Vegetable diseases

^a Brand names have been used only when necessary to clarify the existing con-
fusion concerning the identity of these chemicals.

LY



CONTROL



SIX RULES

For the SAFE use of DDT

1. Don't let any more of the DDT oil solutions get on your skin than you can help. Wash thoroly after spraying.
2. Wear a respirator or handkerchief over your nose and mouth when spraying DDT for any length of time in confined places.
3. Don't let any DDT get directly onto food or into drinking water either in the home or in the barns. The drift of sprays onto feed or into water troughs, in barns, is of little importance.
4. Keep DDT, as well as other insecticides, out of the reach of young children and animals.
5. Do not use DDT on cats.
6. Do not mix DDT with lime or other strongly alkaline materials.

**Correctly handled, DDT presents no dangers
to people or to animals**

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FLY CONTROL . . .

On the Farm and in the House

By W. N. BRUCE and H. B. PETTY¹

COMMON HOUSEFLIES are a serious threat to human health. They help to spread typhoid, cholera, dysentery, diarrhea, tuberculosis, possibly poliomyelitis, and many other human diseases. Millions of germs are carried on their body hairs, wings, and mouthparts, as well as in the alimentary canal. Breeding primarily in decaying organic matter, houseflies frequent barnyards, privies, garbage dumps, putrefying animal carcasses, and other foul-smelling materials before they discover human food upon which to crawl and deposit their cargo of germs. The germs are deposited by direct contact and are also in the specks (vomitings and droppings) which the flies leave wherever they crawl.

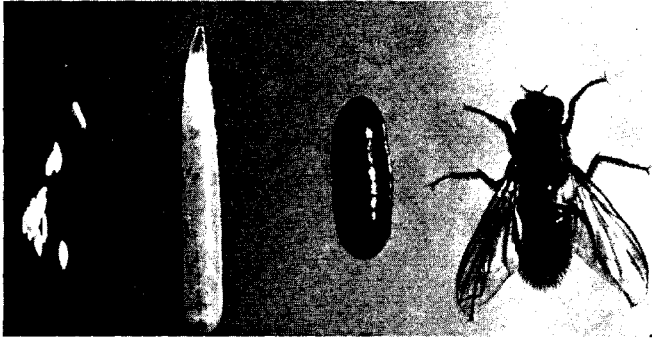
Besides endangering health, flies are an annoyance to both man and animal. For these reasons, many authorities brand the common housefly as man's most dangerous insect enemy. Houseflies, however, are incapable of inflicting any direct injury, as they cannot suck blood.

Stable flies and horn flies, unlike the housefly, are blood-sucking insects. In Illinois their attacks on dairy and beef cattle cost farmers thousands of dollars each year. Because of the loss of blood and the annoyance resulting from attacks by these flies, milk flow may be reduced as much as 15 percent. Beef production is often decreased $\frac{1}{4}$ to $\frac{1}{2}$ pound a day. The livestock feeder and the dairyman will find that controlling these pests not only means a financial gain but also makes the animals less nervous and easier to handle. Both horn flies and stable flies have been suspected of transmitting several diseases of livestock.

¹ W. N. BRUCE, Assistant Entomologist, Illinois Natural History Survey; and H. B. PETTY, Assistant Professor of Entomology Extension, Illinois Natural History Survey and University of Illinois College of Agriculture.

How and Where Flies Live

Houseflies. Houseflies, like all other flies, have four stages in their life cycle — egg, larva (maggot), pupa, and adult. The adults are equipped with flat, two-lobed, sponging mouthparts. With these the flies lap up nourishment from milk, sugar, meat,



Eggs, larva, pupa, and adult of the housefly. Stable flies and horn flies also pass thru these four stages.



A favorite swarming place of houseflies is the garbage can. Note how fly in the insert has pushed out its mouthparts as it gets ready to feed.

blood, manure, or other fly foods. When the adults are about 3 to 5 days old, they begin to deposit their eggs in actively decaying manure, garbage, and similar material. A housefly lays 50 to 150 eggs a day over a period of 2 to 10 weeks. In 10 to 24 hours, the eggs hatch into white maggots about $3\frac{3}{32}$ inch long. These develop rapidly and become full grown (about $\frac{3}{4}$ inch long) in 3 to 7 days. The mature larvae move to drier places and change into reddish-brown pupae about the size of grains of wheat. Adults emerge from these pupae in 4 or 5 days. Thus a generation may be completed in about 2 weeks.

Horn flies. The small bloodsucking horn flies reproduce very rapidly under range and pasture conditions. Large numbers are often present in the spring before there are many other flies. The



Horn flies are found by the hundreds on the backs of unsprayed steers. They are about half the size of houseflies. The enlarged front view shows some other differences between this fly and the housefly.

adults are thick on the backs, shoulders, briskets, and necks of cattle.

Horn flies are not strong fliers and usually stay with one herd of cattle, upon which they feed. The adults leave the animals briefly to lay their eggs upon freshly dropped manure, then return to suck more blood or to rest on the animals and nearby vegetation. The maggots which hatch from these eggs become full grown in about 4 days. At maturity they become pupae, and in 2 or 3 days the adults emerge and feed for a short time before laying eggs to start the next generation. The short life cycle (about 10 days) of these flies, the plentiful supply of blood, and an abundance of material for them to breed on explain their rapid build-up and their large numbers on cattle.

Stable flies. Often called "leg flies" or "dog flies," stable flies are found most frequently on or near their hosts, and near places where they breed. They are numerous under the eaves and on the outside surfaces of buildings; on fences, trees, open sheds, and feeding racks; and in sheltered places. Despite their name,



Stable flies suck blood from cattle and are found commonly on the front legs and shoulders of the animals. They are about the same size as houseflies. Note piercing, sucking mouthparts of stable fly in insert.

however, they usually make up only a small percentage of flies within a barn.

The adult stable fly looks like a housefly but has a prominent proboscis (mouthparts) protruding from the front of its head. The stable fly uses these piercing mouthparts to penetrate the skin of the animal and suck blood. The stable flies' favorite feeding places on cattle are the front legs, shoulders, and neck. The adult flies seek decomposing grass, hay, and straw in which to lay their eggs. The life cycle and stages are similar to those of the housefly but last longer.

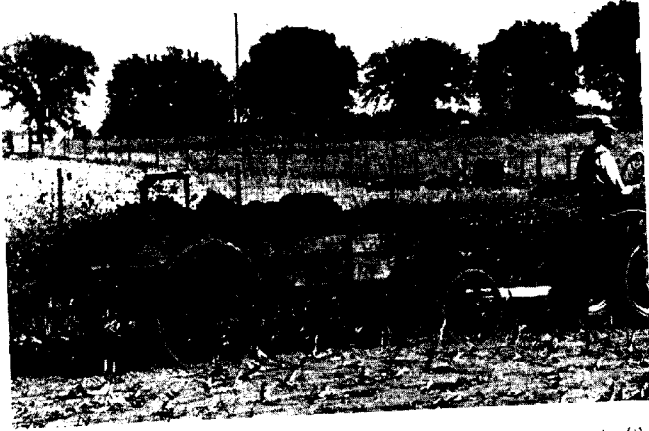
Since these flies breed in numerous places and may fly long distances for a blood meal, all farms in the neighborhood must be treated for most effective control.

Clean-Up Measures Come First

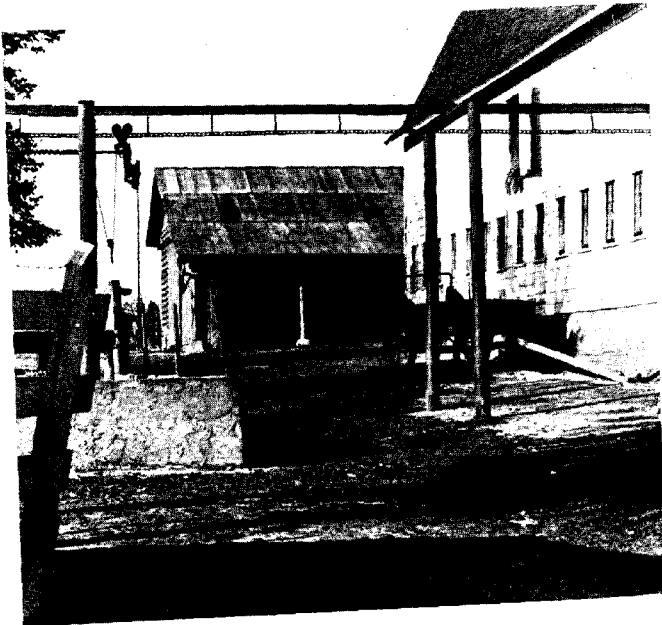
Sanitation will reduce the number of houseflies and stable flies to a point where they may be effectively controlled with the correct use of DDT sprays. Since only 4 or 5 days may be needed for maggots to complete their development, all material where they breed must be disposed of twice a week. Manure should be scattered on fields that need it—not left in piles. Old stack



Flies breed in decaying organic materials, especially manure. Keep all such materials well cleaned up.



Manure should be hauled to the fields twice weekly so that maggots (the larvae of flies) cannot complete their development in it.



A clean barnyard is absolutely necessary for fly control.

bottoms, and feed and other rubbish under feeding racks, should be cleaned up. Garbage should be destroyed. These are all favorite breeding places of flies.

Sanitation will not help in the control of horn flies; for them, insecticides must be relied upon completely.

DDT Most Effective Spray

Several insecticides will kill flies for a considerable time after being sprayed inside buildings. Of these DDT seems most effective and economical. In restaurants and other places where food is handled, however, the DDT or the dying flies may contaminate the food. In these places it may be advisable to use substitutes for DDT.

Emulsifiable DDT concentrates, 50-percent water-wettable DDT, and 5-percent DDT oil solutions are available for use on the farm and in the home. The 5-percent DDT oil solutions are used mostly to paint screens. When used in confined areas or on unpainted wood they may present a fire hazard. *DDT oil solutions should never be sprayed on livestock.*

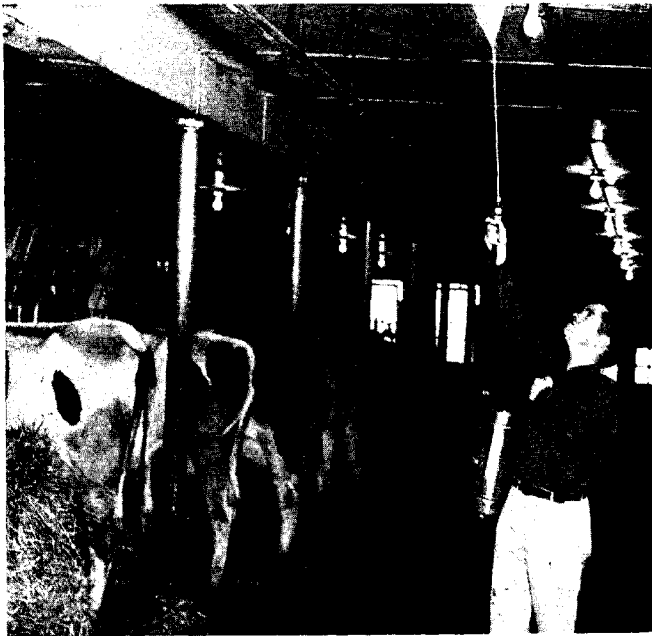
Emulsifiable DDT is commonly sold as a 25-percent concentrate which may be diluted with water to the desired strength. The DDT emulsion is safer for use on animals and in buildings than are the oil solution sprays.

When used at recommended dosages, 50-percent water-wettable DDT is the safest and best formulation for animals and confined spaces. On a wide variety of surfaces, the residual deposit remains toxic longer than the deposits of other formulations. This is especially true of painted, whitewashed, and concrete surfaces. The disadvantage of the wettable-powder deposit is that it is white. Where this white deposit is objectionable, oil solutions or emulsions can be used.

How to apply. There are many kinds of sprayers. The type to be used will depend upon the size of the job and what is available. A power sprayer is generally best for spraying large herds of beef cattle. The person who has several cows and a few barns and sheds can do a good job of spraying with a small compressed-

air sprayer holding 2 to 4 gallons. For applying DDT residual sprays around the home, a paint brush, a small compressed-air sprayer, a paint sprayer, or even a small hand sprayer is satisfactory.

How much to use. For lasting results there should be a deposit of at least $\frac{1}{2}$ pound of actual DDT on every 1,000 square feet of surface where flies roost. If 50-percent wettable powder is used, 1 pound of the powder may be mixed in 2 to 3 gallons of water and applied to 1,000 square feet of surface with a small sprayer. For large sprayers, 32 pounds of wettable powder in 100 gallons of water should be used at a rate of 3 gallons to 1,000 square feet. When 25-percent DDT emulsion concentrate is used in a hand sprayer, 1 quart should be diluted to 1 to 3 gallons with water. This will cover 1,000 square feet. For large sprayers 8



A DDT spray must be applied inside the barn, and it must hit all places where flies roost. A compressed-air sprayer will do the job.



DDT applied to outside areas, such as board fences and the outside of buildings, will not only help to control houseflies, but will also reduce the number of stable flies.

gallons of 25-percent concentrate may be diluted to 100 gallons with water and applied at the rate of 3 gallons per 1,000 square feet. See pages 12 to 15 for the best amounts to use on livestock.

Where to apply. To rid farm buildings of flies, all roosting places must be treated. These include walls, ceilings, rafters, light fixtures, wires, and areas near entranceways. Treating fences and outside surfaces of barns and feed racks will do much to cut down the number of stable flies. The home can be cleared of flies by treating screens, porches, garbage containers, and entrance ways with DDT. It is particularly important to treat outside toilets. Applications to the entranceways of restaurants and food process-



Paint screens every 2 to 4 weeks with DDT. Use a 5-percent oil solution or a 25-percent emulsion reduced to 5-percent strength.

ing plants will kill many flies that might otherwise get inside and become a nuisance.

When to apply. Buildings should be treated in June to prevent a build-up of flies early in the season. Outside surfaces that are exposed to weathering and also frequented by flies should be re-treated at 2- to 4-week intervals thruout the summer. Interiors of buildings may need a second treatment in early September to keep the flies under control.

The following section gives information on the best intervals for spraying livestock.

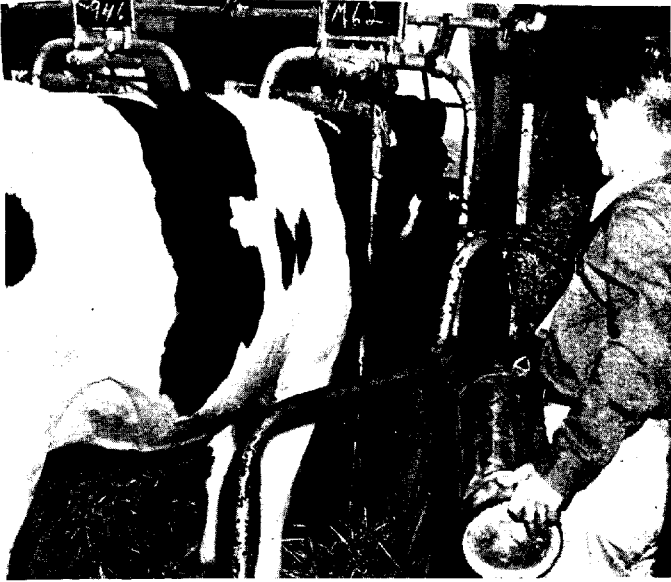
Spray garbage containers, inside and out, and the areas around them, including porches and porch ceilings, at least once a month with DDT.



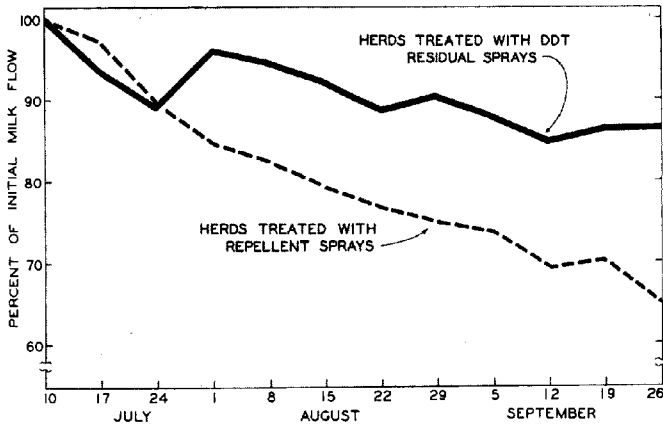
Fly Control on Livestock

Dairy cattle. Spraying dairy cattle with DDT wettable powders will keep the animals free of horn flies and almost free of stable flies. If 50-percent wettable powder is used, mix $\frac{1}{2}$ pound in 3 gallons of water, and apply 1 pint to each cow once a week. Daily applications of 1 or 2 fluid ounces on each cow gives better control but takes more work. In using emulsions, follow the manufacturer's directions.

The first application should be made when flies appear on the animals in the spring. The front legs, shoulders, neck, brisket, and the front half of the body should be thoroly saturated with spray solution. It is not necessary to spray the rear half of an animal, since flies do not frequent the area reached by the tail. Also, spraying only the front part of the cow will virtually do



Stable flies on dairy cows can be controlled by spraying the cows once a week. Only the front half of the animal need be sprayed.



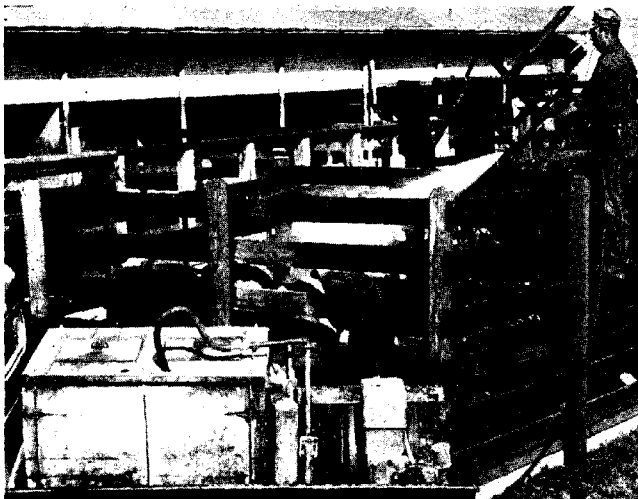
Four herds (16 to 20 cows each) sprayed with DDT produced up to 15 percent more milk than four herds treated with old-type sprays. All barns were treated with DDT 4 weeks before the experiment began.

away with any direct contamination of the milk. Those who greatly fear contamination, however, can obtain a degree of fly control by spraying only the animals which are not being milked.

Stable flies will not entirely disappear with the first treatment, but the number will decrease over a period of 1 to 3 weeks. It takes persistent use of DDT spray on the animals to control stable flies, as they are in contact with the animal for a relatively short time while obtaining a blood meal, and pick up only small amounts of DDT.

Work done by the Illinois Natural History Survey shows that flies can reduce milk production materially and that getting rid of them may bring about as much as a 15-percent increase in milk production. The actual cost of DDT spray is insignificant in relation to the gains that may be obtained in milk yield and in comfort to people and animals.

Beef cattle. Horn flies, which number hundreds per animal, are more of a problem on beef cattle than are stable flies. DDT sprays readily control horn flies, as these flies remain for long



Spraying beef cattle with DDT to control flies means that the animals will put on extra pounds during the summer months.

periods of time upon the treated animals and thus are well exposed to DDT. Also, the horn fly, unlike the stable fly, will not fly great distances for food. Horn flies can be controlled by spraying animals at monthly intervals with 8 pounds of 50-percent DDT wettable powder in 100 gallons of water, or with $\frac{1}{4}$ pound of wettable powder in 3 gallons of water. Apply at a rate of 2 quarts per animal for each application. The first spray will last about 3 weeks and the succeeding applications 4 to 5 weeks. If emulsions are used, follow the manufacturer's directions.

Experimental work in Illinois, Kansas, Oklahoma, and many other states shows that horn-fly control means a considerable gain in pounds of meat and in comfort to the animals. In parts of Oklahoma and Kansas, increased gains of $\frac{1}{2}$ pound of meat per animal per day have been attributed to horn-fly control.

Other livestock insects controlled. Cattle sprayed for the control of flies during the summer months are seldom bothered by attacks of lice during the winter months, as DDT is an effective louse killer. Hog lice may also be controlled by the use of DDT at the concentrations applied to beef cattle. During winter months 5-percent DDT dust may be used at the rate of 1 ounce per animal to control lice.

If fleas are a problem on the farm, the floors of all infested buildings should be treated at the time the applications are made for fly control. Applications made in late spring will prevent a serious build-up of fleas later in the season.

Chicken houses are often sprayed to aid in the control of flies. If the roosts and nests are sprayed at this time, DDT will get rid of roost mites also.

Sheep "keds," or ticks, are easily controlled with DDT sprays or dips containing 4 to 8 pounds of 50-percent water-wettable DDT powder in 100 gallons of water.

FOR GOOD FLY CONTROL

Keep premises clean. Promptly dispose of refuse in which flies breed. This is essential for near-perfect results.

Use residual sprays in barns. Spray $\frac{1}{2}$ pound of actual DDT per 1,000 square feet of surface where flies roost.

Use DDT around the home. Paint screens with DDT, treat porches, and spray garbage containers at least once a month.

Spray livestock. For dairy cattle mix $\frac{1}{2}$ pound of 50-percent DDT powder in 3 gallons of water. Spray each animal with 1 pint a week, or with 1 to 2 fluid ounces a day. For beef cattle use $\frac{1}{4}$ pound of 50-percent DDT powder in 3 gallons of water. Spray each animal monthly with 2 quarts of the solution.

FLY CONTROL MEANS

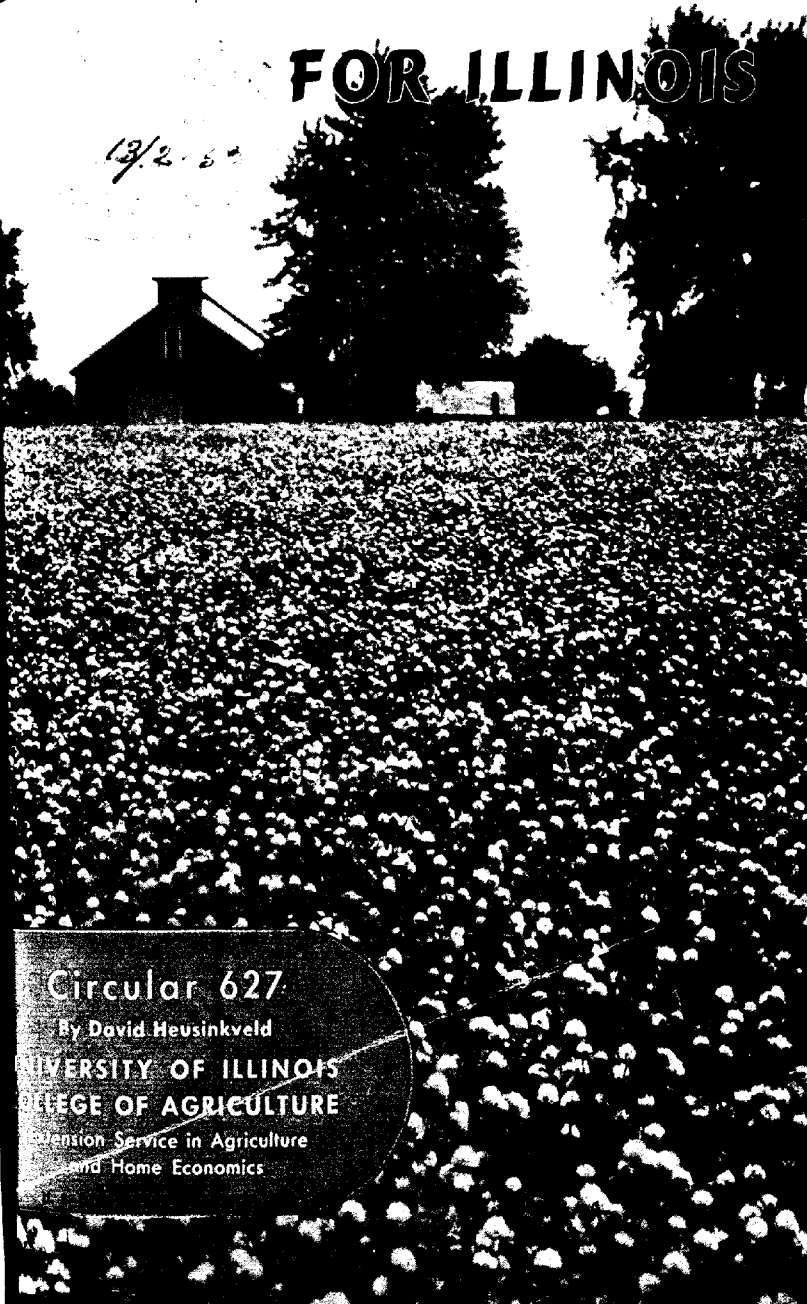
Better health for man and animals · More comfort

Increased milk and meat production

RED CLOVER

FOR ILLINOIS

13/2-55



Circular 627

By David Heusinkveld

UNIVERSITY OF ILLINOIS

SCHOOL OF AGRICULTURE

Extension Service in Agriculture

and Home Economics

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By DAVID HEUSINKVELD

Associate Agronomist, Division of Forage Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, U. S. Department of Agriculture

The recommendations in this Circular are based mainly on cooperative investigations at Urbana between the Illinois Agricultural Experiment Station and Division of Forage Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, U. S. Department of Agriculture.

Urbana, Illinois

September, 1948

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RED CLOVER FOR ILLINOIS

RED CLOVER is one of the most important legume forage crops in Illinois. It fits well into corn-belt rotations and produces high-quality feed for stock. Not so exacting in its soil requirements as some of the other legume crops, it can be grown on many soil types.

Most of the red clover grown in Illinois is used as cured hay, but a considerable amount is also used for pastures, silage, and soil improvement. Red-clover seed is produced on many farms, but yields are often low. Unless a seed crop is desired, red clover is frequently grown with timothy, orchard grass, or other grasses. Clover-grass mixtures are proving entirely satisfactory for feeding livestock.

TYPES AND VARIETIES

There are two main types of red clover: medium red and mammoth red. These types are closely related. The seeds cannot be told apart; they are similar in size, shape, and color. But the plants can be distinguished by their different habits of growth (see pages 4-6). Soil requirements of mammoth and medium red are quite similar, but on poor and sandy soils mammoth often produces more growth in one cutting than does medium red in two cuttings.

Red clover is well adapted to Illinois. Good stands like this are usually obtained by following good farming practices. (Fig. 1)



Medium Red Clover

Nearly all red clover grown in Illinois is the medium red type. Medium red is a perennial; that is, under favorable conditions it continues to grow thru more than two seasons. On most Illinois farms, however, it is treated like a biennial (two-year) crop because of its place in the rotation. Also, insects and diseases often cause so much damage by the end of the second season that practically all the stand is gone. Only occasionally is red clover productive the third year.

In early stages of growth medium red clover is similar to mammoth. In the autumn of the first season it can be distinguished from mammoth by the fact that it produces stems and flowering heads while mammoth has only crown leaves. Medium red clover may produce a small amount of seed the first year if it isn't clipped.

During the second season two crops and an aftermath are produced; both crops may be cut for hay or the first cut for hay and the second left for a crop of seed. Usually the aftermath furnishes some pasture for livestock.

The time of blooming varies with the climate and the area where the clover is being grown. In central Illinois the first crop of the second season usually starts blooming about June 1 and is in full bloom by June 10.

The stems of medium red are finer than those of mammoth, and growth is less rank. The hay is therefore of better quality and higher feeding value than that obtained from mammoth.

Within recent years three strains of medium red clover, adapted to certain areas of the principal clover-growing region, have been given varietal names.¹ These are Midland, Cumberland, and Kenland.

Midland. This variety is particularly adapted to the central part of the corn belt. It may, however, be grown thruout all of Illinois except possibly the southern part, where southern anthracnose, a common disease of clover in this area, may cause serious damage.

¹ Altho red clover has been grown in this country for many years, the need for using adapted seed has not been generally recognized. It is only within recent years that a few superior strains have been developed and given varietal names.

Midland was originated by combining, in equal proportions, four old strains — one each from Ohio, Indiana, Illinois, and Iowa. It grows vigorously, is winter-hardy, and has some resistance to northern anthracnose — a disease that may attack red clover and cause some damage to the first crop in the second season.

Cumberland and Kenland. Cumberland originated as a composite made up of equal proportions of three superior strains, one each from Virginia, Kentucky, and Tennessee. Cumberland produces an abundance of above-ground growth and is somewhat resistant to southern anthracnose and crown rot. Kenland, the most recently named variety of red clover, is quite similar in origin and growth to Cumberland. It is, however, more resistant to southern anthracnose and will yield more forage than Cumberland when this disease is prevalent.

In tests at Urbana, Cumberland and Kenland have been more susceptible to northern anthracnose than Midland and other corn-belt strains. These two varieties are not recommended for general use in Illinois but they may be of value in southern Illinois and in other areas where southern anthracnose is likely to occur.

Seed supplies. Supplies of both Midland and Cumberland seed are becoming more abundant. A limited amount of seed is produced in regions where they are adapted. Considerable seed of both varieties is produced in several of the northwestern states under supervision of state crop improvement associations. Seed of Kenland is still scarce. As the acreage of this variety increases, more seed will become available.

Local strains. Thruout Illinois are strains of medium red clover that have grown in the same locality for so many years that they have become adapted to local conditions of soil and climate. Several of these strains are known by the name of the grower or by the name of the county where the seed is grown. These strains have not been widely used. However, because of their superior qualities, seed supplies of these strains should be increased for general use where adapted.

Mammoth Red Clover

Altho mammoth red is a perennial plant, it, like medium red clover, is usually treated as a biennial. It starts blooming 10 days or two weeks later than medium red and is in full bloom about when timothy is. At this time bumblebees and other pollinating insects are numerous, thus insuring pollination of the flowers.

In the fall of the first year mammoth red can be distinguished from medium red by its low crown growth and lack of flowering stems. Only one crop, either of hay or seed, is harvested the second year. The aftermath is scant and of little value as a fall pasture. Stands tend to thin out after a crop of hay or seed has been taken.

Mammoth red clover grows taller than medium red clover, and its stems are coarser, making it less desirable as hay.

At Urbana three named varieties of mammoth red—**Graham**, **Knollman**, and **Altaswede**—have been tested in comparison with commercial seed lots. In yield of forage Graham and Knollman are equal to or somewhat better than commercial seed lots. Altaswede, developed in Canada from foreign seed, is winter-hardy, but otherwise not adapted in central Illinois.

ADAPTED SEED NECESSARY

High-quality seed, adapted to the locality, is essential for profitable stands of red clover. Good red-clover seed is plump and bright, varies in color from yellow to purple, and is free from weed seeds. Seed of good quality usually germinates well, altho some hard seeds may be present. (Hard seeds are viable but require a longer time to germinate.) Some brown seeds, many of which are dead, are nearly always present. A high percentage of brown seeds is often found in old seed.

Red-clover seed grown in any locality for a number of seed generations is usually as good as or better than seed from other sources. Strains adapted to Iowa, Indiana, and Ohio are generally adapted in the same latitude in Illinois. Seed produced in the northwestern states from superior corn-belt strains keeps its desirable qualities when returned to its place of origin.

Strains developed in Canada and the northern states are winter-hardy, but in other ways they are not so well adapted to Illinois as strains grown in the central corn-belt states. Strains from the Pacific coast region of Oregon and Washington are not so hardy as many other strains grown in this country. European and South American strains generally are not winter-hardy, their yields of forage are not likely to be satisfactory, and stands are frequently lost.

SOIL MANAGEMENT

While adapted to a variety of soils, red clover thrives best on well-drained, moderately heavy loams that are somewhat moist but not too wet. It does not do well on sandy or gravelly soils unless an ample amount of moisture is present at all times. It is usually impossible to obtain good stands on soils that have been depleted of plant-food elements and organic matter. Thru good soil management, however, poor soils can be built up so that eventually red clover can again be grown.

Add Limestone Where Needed

Many failures of red clover that are laid to other causes may be due to too little lime in the soil. Red clover, however, is not so exacting in its lime requirements as are alfalfa and sweet clover. It makes its best growth on soils that are at or just below the neutral point. It does not always do well on moderately acid soils. On such soils clover-grass mixtures are more likely to be successful than pure clover plantings.

The degree of acidity which red clover can withstand depends mainly on the amount of plant food in the soil. With a good supply of available nutrient materials, clover can stand more acidity than if it is half-starved.

Winterkilling is more likely to occur on acid soil than on sweet soil. This is because plants growing on sweet soil have a chance to make good growth before cold weather.

Finely ground limestone is generally used to correct soil acidity. The amount needed is determined by testing soil samples taken from a number of spots in the field. Soil samples may be sent to the office of the county farm adviser, where tests are

made and recommendations given for the amount of limestone needed in order to get a good growth of various legumes.

Chemical Nutrients Necessary for Clover

Phosphorus and potassium are essential for the growth of red clover. An ample supply of phosphorus in the soil is especially helpful in establishing stands. A number of minor elements are also necessary for growth, but there is enough of these in most Illinois soils.

Soils vary greatly in the amounts of phosphorus and potassium present. Generally there is a greater deficiency in phosphorus than in potassium. A soil test will show whether there is a need for either or both of these elements.

A shortage of phosphorus may be corrected by the use of rock phosphate or superphosphate. If supplies of both phosphorus and potassium are too low, then muriate of potash, in addition to phosphorus, will be helpful. These potassium and phosphorus fertilizers may be applied with a drill when the clover is planted. Commercial fertilizers used for a cultivated crop often benefit the red clover crop that follows.

Manure Is Helpful

On many soils, especially poor and sandy soils, manure does much to insure good stands. The favorable effect of the manure is due largely to the minerals and organic matter it supplies. Most farmers use manure for the cultivated crop that comes before the clover. Both crops benefit from this practice.

Manure used as a mulch helps to get good stands on soils that are subject to wind erosion.

Inoculation Is Important

Thru a process known as nitrogen fixation red-clover plants are able to change free nitrogen in the air to a form they can use immediately. Bacteria are the nitrogen-fixing agents. They form small nodules on the roots. Inoculation, the process of supplying bacteria, occurs naturally or may be done artificially.

Soils on which red clover has been grown for several years usually contain enough bacteria to provide natural inoculation. If a soil has not grown red clover, the seed should be inoculated artificially. Commercial inoculants sold by most seed dealers are usually satisfactory and the cost per acre is small.

Well-nodulated red clover is a vigorous gatherer of nitrogen; an entire crop, including tops and roots, often contains 100 pounds or more of this element to the acre. Part of this nitrogen remains in the soil for succeeding crops. Plants that are not nodulated are low in nitrogen. Instead of adding nitrogen to the soil, they take it out of the soil, and they usually do not survive.

RED CLOVER IN CROP ROTATIONS

Crop rotation is the growing of two or more crops in regular sequence on the same land. Its purpose is to make the best use of the plant food in the soil and, at the same time, keep the soil in condition that will give the best yields of the various crops. The rotation system that will give the best results depends upon the kind of soil and type of farming.

Value of Clover in Rotations

Red clover has several characteristics that make it a good legume to include in rotations with grain. It is adapted to a wide range of soil conditions and is excellent for hay and pastures either alone or in mixtures with grasses or other clovers. Medium red, the type usually grown in Illinois, produces two crops and an aftermath. Also, red clover adds nitrogen to the soil, provided considerable plant material is plowed under.

Possible Rotations

The best place for corn in a rotation is after the legume crop. One short-cycle rotation includes corn the first year; oats or wheat (clover seeding) the second year; and clover the third year. Tho this rotation provides less cash income than some others, it is good for maintaining organic matter and soil fertility.

In Illinois, where corn and soybeans are major farm crops, an excellent four-year rotation is: (1) corn; (2) soybeans;

(3) oats or wheat (clover seeding); and (4) clover. This rotation is adapted to fertile soils well supplied with organic matter.

Where winter wheat is the major grain crop, the rotation might be (1) wheat; (2) wheat (clover seeding); and (3) clover. If it is desired to grow corn or possibly oats once in the cycle, the rotation is: (1) corn; (2) oats or wheat (clover seeding); (3) clover; and (4) wheat (clover seeding).

These rotations are well adapted to either grain or mixed farming, since the clover makes excellent hay and pasture for livestock. Another year of hay or pasture may be added by seeding timothy or brome grass with the clover instead of seeding clover alone. If the clover should fail, soybeans may be substituted and cut for hay or left for seed, or corn may be planted. Altho crop rotations that include red clover help to maintain soil fertility, crop residues and manure must also be turned back into the soil.

ESTABLISHING STANDS

Value of Companion Crop

It is not absolutely necessary to seed clover with a companion crop (often called a nurse crop). Companion crops do, however, provide some revenue from the land while the clover is becoming established and they also prevent excessive weed growth. Usually the companion crop is allowed to mature and a crop of grain harvested. If a crop of grain is not desired, the field may be pastured moderately or cut for hay when the grain has reached the milk stage.

Time, Method, and Rate of Seeding

The time to seed red clover depends largely on climatic conditions and the grain crop with which it is sown. When planted in winter wheat, clover seed may be broadcast as early as February or the first part of March.

Seed scattered in winter wheat by one of the several types of broadcast seeders must be covered to insure germination. If the seeding is early (February or the beginning of March), alternate freezing and thawing will work the seeds into the soil.

After the freezing-and-thawing period has passed, seed may be covered by using the harrow, care being taken not to cover the seed too deep. Crosswise drilling or harrowing will not damage the wheat. If seedings are delayed until the soil has become dry, it is advisable to drill in the seed.

When grown with spring grain, clover is seeded at the same time as the grain. Grain drills with two compartments are commonly used. On all but sandy soils, clover seed should be planted shallow, less than 1 inch deep. The use of a corrugated roller on dry seedbeds before and after seeding often helps to get good stands. Seeds germinate more readily in a firm seedbed than in dry, porous soil, and the seedling plants have a better chance to get a good start.

Red clover may be planted without a companion crop in May or June after it is too late to seed spring grains. Seeded in this way, clover may produce a good crop of hay the first season. Where weeds are abundant, however, the hay will be of poor quality and the stands are likely to be thin. When red clover is seeded alone, seedbed preparation and depth of planting are the same as when clover is seeded with spring grain.

Experiments have shown that it is not necessary to plant more than 10 pounds of red clover seed to the acre. Five pounds, on the other hand, is not enough. Many Illinois farmers use a bushel for 8 acres, planting at the rate of $7\frac{1}{2}$ pounds an acre.

MANAGEMENT THE FIRST SEASON

Red clover seeded with grain needs little attention the first year. Generally the companion crop is permitted to ripen and is harvested with a combine or binder. Occasionally a rank grain crop may have to be removed as a hay crop or it will smother the clover stand. After the grain crop has been taken off, the clover plants develop and give some pasturage. During very favorable seasons a crop of hay or a light crop of seed may be harvested.

Even tho red clover, planted with or without a companion crop, may give some forage or seed the first season, there are always hazards to be considered. Clipping after the first of Sep-

tember, for example, may result in winter-injury and loss of stands. Too heavy grazing in the fall may have the same results. Also, weeds may choke out the clover stands.

It is advisable to clip clover during August. If stands are weedy, clipping is especially important. The weeds should be allowed to make considerable growth and then clipped low. In this way more weeds are killed than if the cutter bar is raised several inches. Red-clover plants, however, recover from crown buds at the ground level and are not injured. Clippings should be taken off the field if sufficient to provide some feed or heavy enough to injure the stand. Field mice are likely to cause severe damage on fields where heavy fall growth has been clipped but not removed.

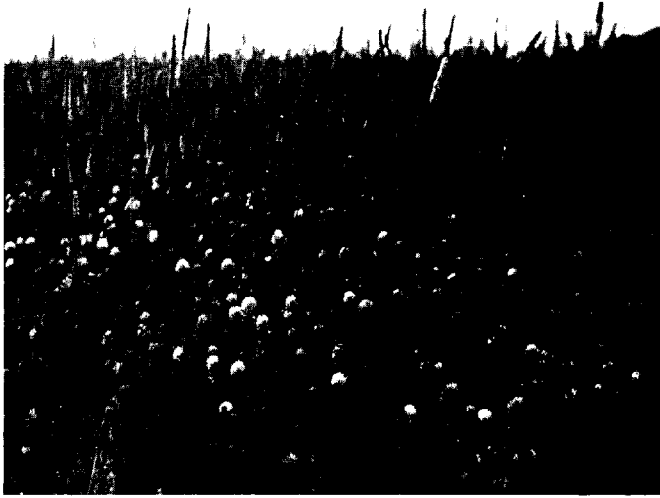
RED CLOVER AS HAY

On many farms red clover is the standard legume for hay. All classes of livestock readily eat red-clover hay. Its protein content is more than twice that of timothy but slightly less than that of alfalfa. When high-grade clover hay is fed to dairy cattle, the amount of grain concentrates necessary for good milk production is considerably less than when clover hay is not fed.

Illinois farmers often seed grasses with red clover. Yields of hay both from clover-grass mixtures and from pure clover are higher than from grasses alone. This is indicated by the following yields, which were obtained at Urbana:

	<i>Pounds of hay per acre</i>	
	<i>1944</i>	<i>1945</i>
Clover-timothy.....	5 300	5 520
Clover-orchard grass.....	4 920	4 360
Clover-bromegrass.....	5 500	5 880
Clover.....	5 180	6 040
Timothy.....	2 540	2 900
Orchard grass.....	1 320	1 340
Bromegrass.....	3 220	3 500

Grasses grown with legumes contain more nitrogen, and thus more protein, than grasses grown in pure stands. This fact is shown by chemical analyses, and is also apparent to the eye. Grasses growing with legumes are greener than grasses growing alone. This indicates that the legume provides nitrogen for the grass.



Clover-grass mixtures make excellent hay and are better for controlling erosion than red clover alone. This is a timothy mixture. (Fig. 2)

When to Harvest the Hay Crop

Most of the red-clover hay in Illinois comes from the first crop of the second season. For the best quality hay, this crop should be cut when the protein content is relatively high, leaves are intact, and the stems are green. The percentage of protein in clover hay is high when the first heads come in bloom and decreases each week until the plants are mature. The yield of hay per acre increases steadily from the time the first flowers appear until they are a few days past the full-bloom stage. The total amount of protein per acre is highest about the time half the heads are in bloom. For relatively high yields of both hay and protein, therefore, the first crop should be cut during the half-bloom to full-bloom stage.

Another advantage of cutting the first crop early is that the

yield of hay from the second crop will be increased. The second crop should be cut at the full-bloom stage. Hay will be of higher quality if cut at this stage than if the crop is allowed to become more mature.

Much of the red-clover hay produced in Illinois is cut too late to be of the highest quality. Corn and soybeans need cultivation when the first crop of clover should be cut for hay, and consequently farmers often delay cutting the clover until it has passed its best stage.

Methods of Harvesting the Hay Crop

One secret of making high quality hay lies in the curing process. Hay carefully cured in the sun so that it keeps most of its green leaves and original green color is high in carotene, which is the source of vitamin A.

Clover should not lie in the swath until completely cured. If it does, it will lose many of its leaves when handled. Windrowing is the best way to speed up the drying and at the same time obtain high quality hay. The hay should be left in the swath until well wilted, then windrowed with side-delivery rake and left in the windrow until dry enough to put in the mow or bale. Partly cured hay should not be left in the swath overnight, since dew will cause considerable loss of green color. The advantages of windrowing are that (1) few leaves are lost, (2) most of the bright green color is kept, and (3) windrows are easily picked up by the hay loader and the pickup baler.

The mower, rake, and hay loader are commonly used for making hay. Increased labor costs and shortage of labor are changing haying operations. Tractors are being used more and more to operate the machines. Also, the pickup baler is beginning to take the place of the hay loader. A recent type of pickup baler requires only one operator for the entire process. The bales are smaller and are tied mechanically with twine instead of wire.

Hay should be reasonably dry when put in mows, stacks, or bales. If moisture content is high, spontaneous combustion may cause fires, resulting in the loss of farm buildings. To be safe from fire hazard and spoilage, hay should contain not more than 25 percent moisture, and preferably somewhat less.

RED CLOVER FOR PASTURES

Red clover is an excellent pasture for all kinds of livestock. Like alfalfa, however, it may cause bloat. A mixture of red clover and grasses is less likely to cause bloat than pure stands of clover. Timothy is usually seeded with red clover for pastures, altho a wide variety of grasses may be used.

During the fall of the first season, red clover may be pastured but *not too heavily*. Close grazing keeps red clover plants from making their normal fall growth. While making their growth, the plants take nitrogen and carbon dioxide from the air and manufacture food materials which are stored in the roots. The plants need these foods in order to endure low winter temperatures and start vigorous growth in the spring.

During the second season, after two crops of hay or one crop



All classes of livestock make good gains when pastured on clover-grass mixtures. Danger of bloat is less than on pastures of pure clover. Many kinds of grasses can be seeded with red clover. (Fig. 3)

of hay and a crop of seed have been harvested, the aftermath furnishes a limited amount of pasturage. Usually many plants die after a crop of seed has been cut and threshed.

RED-CLOVER SILAGE

Red-clover silage is palatable to all classes of livestock. It is especially valuable for dairy cows requiring high-protein rations. Clover keeps more of its carotene content when it is ensiled than when it is made into hay. Carotene, the source of vitamin A, gives a yellow color to milk.

For greatest feeding value, clover should be made into silage when the crop is well in bloom. Clover can be ensiled even when the weather is not ideal for curing hay. Clover ensiled when wet with rain will be low in dry matter.

Since red clover is relatively high in protein and low in sugar, it should be mixed with phosphoric acid, molasses, or ground shelled corn. Sixty to 80 pounds of molasses, 15 pounds of phosphoric acid, or 80 to 100 pounds of shelled corn should be used for each ton of green clover.¹

RED CLOVER FOR SEED

Insects Necessary for Pollination

Red-clover flowers are practically self-sterile. This means that very seldom will the pollen of a flower fertilize either that flower or any other flower on the same plant. For fertilization to take place it is necessary that pollen be transferred from the flowers of one plant to the flowers of another plant. A large number of pollinating insects is needed for the production of high yields of red-clover seed.

Several species of insects transfer red-clover pollen. Bumblebees and a number of species of wild bees are especially efficient. Opinions differ as to the value of honeybees as pollinators of red clover. Apparently when other sources of nectar and pollen are available red clover is not attractive to the honeybee.

¹For a more complete discussion of directions for making silage, see Illinois Circular 605, "Grass and Legume Silages for Dairy Cattle."

Most Seed Produced Second Year From Second Crop

Red-clover plants produce seed whenever the plants are left long enough to mature. Occasionally clover sown in the spring, either alone or on a grain crop, will produce a light seed crop the first season. It is commonly thought that producing seed the first season will weaken or destroy clover stands. Loss of stands, however, is likely to be caused by improper fall management and not by the production of seed.

Even tho some seed may be produced the first season, most red-clover seed grown in Illinois is harvested the second season, usually from the second crop. The first crop of the second year can be harvested for seed; and occasionally, when conditions are very favorable, the first crop will even produce more than the second crop. Usually, however, the first crop is needed for hay or pasture. Also, seed-producing conditions are generally better for the second crop. For one thing, the weather during the blooming and ripening period is usually clear and dry. Also, there are generally more pollinating insects during July and August than earlier in the season, and at the same time fewer flowers of other plants to attract the insects. Harmful insects like the clover seed midge and the clover seed chalcid usually cause the least damage to the flowers and seed of the second crop. Finally, growth of the second crop is less rank than that of the first. This, too, favors seed production.

Time of First Cutting Is Important

If the second crop is to be used for seed, the first crop should be removed not later than the full-bloom stage and before the heads have turned brown. Early cutting of the first crop gives the second crop a chance to develop rapidly and vigorously. Also, attacks of some harmful insects may be less severe.

Cutting the first crop of red clover one or two weeks after full bloom often reduces the seed yield of the second crop by nearly half. This was found in experiments at the Ohio and Michigan Agricultural Experiment Stations and in preliminary tests at the Illinois Station.

Harvesting the Seed Crop

Red clover for seed should be cut when the heads have turned brown and the seeds have become hard but before they start to shatter. Shriveled seed is usually caused by cutting the crop too early. Ripe clover may be cut any time of the day. If the plants are very dry, however, they should preferably be mowed when they are wet with dew, and windrowed before the heads become dry. This will keep the seed from shattering very badly. Clover may be windrowed with a bunching attachment on the mower or a side-delivery rake.

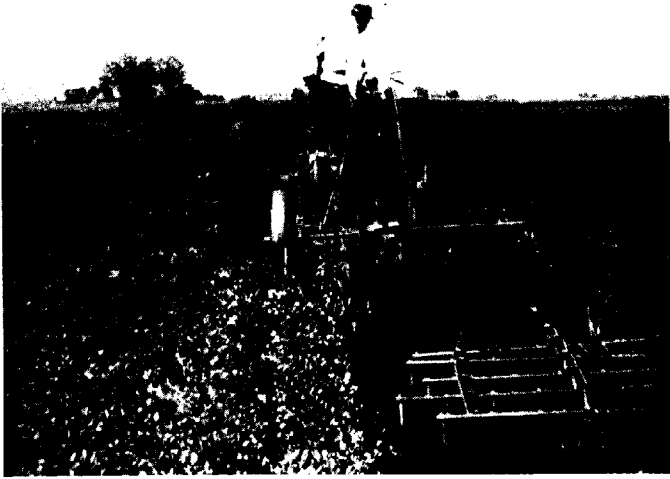
Several types of machines are used successfully to separate the seed from the pods. Special machines called clover hullers are used in some places. Grain separators with hulling attachments are also used. Grain combine harvesters, however, are rapidly taking the place of these older types of hulling machines. Combines operated in the field either as stationary or pickup machines are now commonly used to hull clover seed. Occasionally fields of standing clover are combined; however, a good job of hulling cannot be expected unless all the seed is ripe and the plants thoroly dry.

Clover Seed Should Be Cleaned

Clover seed used on the farm or offered for sale should be free from weed seeds, foreign matter, and immature and shriveled seeds. Fanning mills, properly operated, generally clean seed enough to meet most market requirements. Commercial seed dealers and grain elevators usually maintain seed-cleaning equipment. In some localities equipment mounted on trucks is used for custom seed-cleaning.

RED CLOVER FOR SOIL IMPROVEMENT

Like other legumes red clover takes nitrogen from the air and converts it into forms which can be used by the growing clover (see pages 8-9) and also by grasses growing with it. A 4-ton crop of clover hay may contain as much as 150 pounds of nitrogen, as well as 20 pounds of phosphorus and 120 pounds of potassium.



Turning under a clover crop is a good farming practice. Red clover enriches the soil with nitrogen, and also helps to maintain good tilth by mellowing and granulating the soil. (Fig. 4)

Of the total nitrogen in clover, two-thirds is in the plant above the ground and one-third is in the roots. When two crops of clover have been removed from the land, the nitrogen left in roots and stubble is about equal to that taken from the soil by the crop. Nitrogen is the only plant food that can be maintained just by properly rotating crops.

If the clover crop is to build up the nitrogen content of the soil, rather than merely keep it at the same level, more of the clover than just the roots and stubble must be returned to the soil. Whatever use is made of the clover crop, its value for soil improvement depends upon how much of the crop is returned to the land either as green manure or as barnyard manure and crop residues.

Besides enriching the soil with nitrogen, red clover mellows and granulates the soil and thus helps to keep it in good tilth. Since red clover is a sod-forming crop, it also protects the soil, reducing soil erosion. Clover-grass mixtures, however, protect the soil better than clover alone.

RED-CLOVER FAILURES

Recent years have seen an increasing number of entire or partial failures of red clover. Failure of a red-clover seeding to produce a good stand or an abundance of forage and seed may be due to one or more causes. The most common are: (1) unadapted or poor seed, (2) lack of inoculation, (3) wrong methods of seedbed preparation, (4) soil acidity and lack of plant nutrients, (5) competition of grain crops and weeds, (6) improper management the first season, (7) insects and diseases, (8) drouth, and (9) winterkilling. Clover failures in Illinois have been more frequently attributed to a lack of lime in the soil than to any other condition.

Good methods of farming will usually get rid of the first six causes for clover failures. Insects and diseases, drouth, and winterkilling are more or less beyond the control of man; yet they too may be partly controlled or combated.

Insects and diseases are present to some extent each year. Altho they seldom cause complete clover failures in Illinois, they doubtless cause partial loss of stands or reduce the yields and quality of forage and hay. Strains of red clover that are resistant to specific insects and diseases have considerable value.

In regions where crop production depends upon rainfall, drouths are likely to occur. While man cannot control drouth, he can partly control its effects. When soils become dry it may mean the difference between success and failure if a dry loose seedbed is culpacked or a companion crop removed before the seedlings die.

Red clover stands are often winterkilled. Winterkilling caused by late summer planting, use of unadapted seed, or untimely clipping can be largely prevented. There is, however, little or nothing to be done about winterkilling caused by the weather. Alternate periods of mild and subzero temperatures, with no snow cover, are frequently disastrous to clover stands. Mulching a clover meadow with straw does provide some protection against the cold and also tends to prevent heaving, which may injure or even kill clover stands. On large fields, however, mulching is usually impractical.

INSECT PESTS OF RED CLOVER

Many insects feed on red clover, different kinds of insects varying in their preference for tops or roots. As previously stated, insects cause some damage and may reduce the yield of forage, but rarely cause complete failures. Among the insects attacking red clover, seven species are most commonly found.

Clover leaf weevil (*Hypera punctata* (Fab.)). The greenish larvae of the clover leaf weevil feed on red-clover leaves early in the spring. They may be found at the base of plants during the day, but they do most of their feeding at night. Their presence is indicated first by small holes in the leaves, and later by irregular patches eaten from the margins. During April and May a raggedness is sometimes very noticeable in the clover plants.

Seldom is an entire crop lost, but considerable injury may occur before the larvae are killed by a fungus disease to which they are very susceptible.

Lesser clover leaf weevil (*Hypera nigrirostris* (Fab.)). The adults and larvae commonly feed on red clover but they may also attack alsike clover. The larvae will attack newly forming buds and heads of the first crop. Buds may be blasted, and new heads may fail to develop. The larvae may also eat into the stem and even partially tunnel into it. The adults feed on the leaves, riddling them. Parasitic insects attacking the larvae apparently hold this pest in check.

Potato leafhopper (*Empoasca fabae* (Harris)). This leafhopper is a very small, quick-jumping, pale green insect that is not easily detected unless extremely abundant. It punctures the foliage of red clover and sucks out the juices, causing the leaves to turn reddish or yellow. The potato leafhopper, however, seldom does much damage to the well-adapted, native strains of medium red clover in Illinois. Red-clover strains developed in this country have hairy stems and leaves which enable them to resist leafhopper attacks much better than foreign red-clover strains whose stems and leaves are only slightly hairy.

Clover root borer (*Hylastinus obscurus* (Marsh.)). The clover root borer is one of the most destructive enemies of red clover; this pest, however, is not equally serious in all regions where red clover is grown. Rarely does the root borer work in plants before they are a year old. Then it tunnels in the roots, where it lays its eggs. The eggs, small larvae, and even the dark-brown adults may be found in the cavities. Because of their weakened root system, affected plants are apt to break off at the ground level. Also, the damage to the roots provides entrance for fungi that may cause crown and root rots. A badly infested field should be plowed as soon as possible after the first crop of hay is removed. With the death of the plant, the larvae also die.

Clover seed midge (*Dasyneura leguminicola* (Lint.)). This insect does much damage to the red-clover seed crop. It is a small fly that lays its eggs

in the blossoms. The tiny larvae injure the blossoms so that seeds are not formed. This pest can be controlled to a large extent by cutting the first crop before the larvae are mature. They will then die from lack of food. Early cutting of the first crop hastens the development of the seed crop, so that the flowering heads will be too far advanced for the second brood to cause much damage.

Clover seed chalcid (*Bruchophagus gibbus* (Boh.)). This small, wasp-like insect is very destructive to the seed crop. It lays its eggs in newly formed seeds. The larva develops inside the seed, eating it all except the coat. The adult emerges thru a small round hole in the coat. A practical aid in control is cutting or pasturing the first crop early so that a seed crop will be produced before there are very many of the insects.

Grape colaspis (*Colaspis flavida* (Say.)). The larvae of this insect are curve-bodied and short, having a length of $\frac{1}{8}$ to $\frac{1}{6}$ inch. They feed on the roots of red clover and many other plants. The adults are clay-yellow beetles about $\frac{3}{16}$ inch long. When good crop rotations are followed, this insect does little damage to the clover crop.

Corn planted on clover sod heavily infested with the larvae may be severely damaged. Reddening of seedling corn plants is usually a sign that the larvae are feeding on the corn roots. Late planting and the use of phosphate fertilizer at planting time will help to prevent losses to this crop.

RED-CLOVER DISEASES

A number of diseases may attack red clover, but they seldom cause much loss in Illinois before the end of the second season. One or more diseases may be present during the life of the crop.

Leaf diseases. Several kinds of leaf diseases may be found in a clover field. There may be spotting, discolored areas, or leaves entirely blackened. Usually these diseases are most severe on leaves at the base of the plant, where conditions are most ideal for fungus development.

Powdery mildew, *Erysiphe polygoni* DC., is a leaf disease occurring on red clover and also on other clovers. It appears as a white to light-gray powdery dust on the leaves of infected plants. It is likely to be most common when rainfall is light. Severe infections may reduce both yield and quality of hay. Experiments have shown that hay heavily infected with the disease may be fed to animals without hurting them. No practical method of controlling the disease has been found. However, thru selection of resistant plants it is possible to build up clover strains that are highly resistant to the disease.

Northern anthracnose (*Kabatella caulivora* (Kirchn.) Karak.). This disease occurs most often in the northern part of the red-clover growing region, but it may occur thruout all of Illinois. It can be readily recognized by the dark-colored injuries on the stems, petioles (leaf stems), and leaves.

These parts may finally be completely girdled, as the spots grow larger and spread together. Girdling of the affected parts causes them to wilt and finally die. Plants that have been attacked by the disease have a scorched appearance: the foliage droops, becomes almost black, and is very dry.

In central Illinois this disease generally appears in late May or early June. It develops rapidly when the temperature is cool and humidity is high. It does not kill the plants, but severe infection reduces the yield and quality of the first crop of hay. Even tho the first crop may be badly infected, the second crop is apt to be entirely or almost free from the disease and produce a crop of hay or seed. There are not yet any practical measures that will control the disease. Varieties and strains differ considerably in their resistance, but none is entirely immune. It is probable that thru selection and breeding, red-clover strains highly resistant to the disease will be developed.

Southern anthracnose (*Colletotrichum trifolii* Bain & Essary). This disease is confined largely to the southern part of the clover belt. In Illinois it is most apt to occur in the southern part of the state but in unusual seasons it may occur almost anywhere.

The symptoms are very like those of northern anthracnose. The disease develops rapidly during midsummer when the temperatures are relatively high. The fungus attacks the new shoots of the second crop; these in turn may infect the crown and roots. When the entire plant is infected, it quickly dies.

This disease has caused an enormous amount of damage in the southern part of the clover belt. Many stands of clover have been completely killed, resulting in the loss of either a crop of forage or a crop of seed. Cumberland and Kenland, varieties developed within recent years, are partially resistant to this disease but very susceptible to northern anthracnose.

Other red-clover diseases. There are several mosaic diseases of red clover which are caused by viruses transmitted by aphids and leafhoppers. These diseases cause mottling of the leaves and sometimes dwarfing of the plants. Within recent years crown and root rots have caused considerable damage to red-clover stands in their second year of growth. Very little is known about the mosaics and crown and root rots, and measures for their control have not been developed.

Black-stem disease and rust are fungus diseases that may cause damage when conditions are right for their development.

*Some of the more important points
covered in this Circular are
summarized on the next page.*

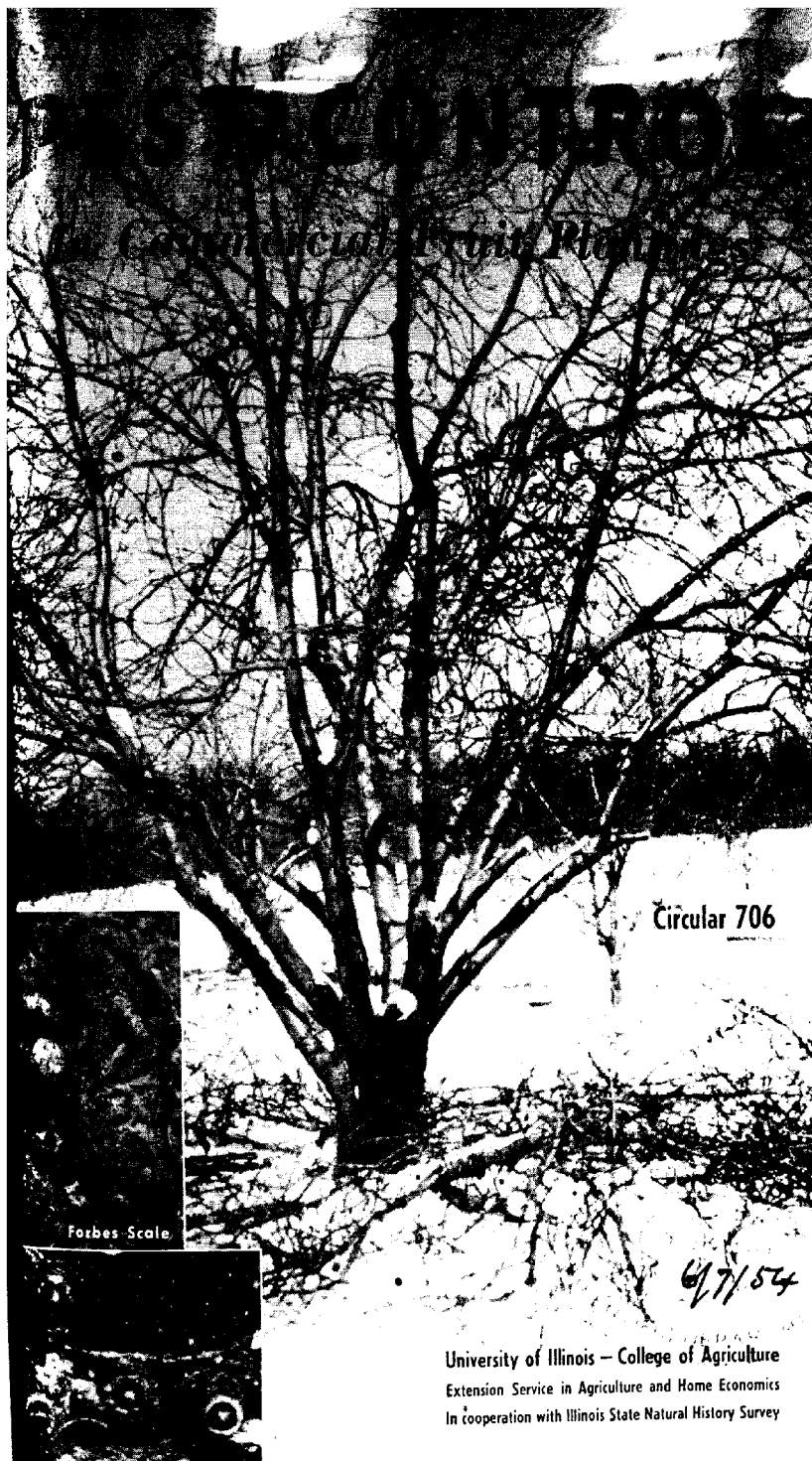
RED CLOVER is one of the important forage and soil-improving crops in Illinois. It fits well into crop rotations adapted to grain or mixed farming. It makes excellent hay and pasture for livestock, especially if it is grown with timothy or other grasses. Altho less exacting in its soil requirements than some of the other legumes, it thrives best on well-drained soils containing good supplies of lime, organic matter, and plant nutrients.

Time to sow. Red clover is usually sown in late February or early March on winter wheat or in March or April with a spring grain. Late-spring or early-summer seedings, without grain, are generally successful if the soil has plenty of moisture.

Cutting for hay and seed. The first crop of the second year produces the most hay. The second crop usually yields the most seed. For high-quality hay, the first crop should be cut before the full-bloom stage. Also, if the first crop is cut early, the seed crop is usually larger than if the first cutting has been delayed.

Curing hay. One secret of making high-quality hay is to cure it properly. Clover left in the swath until dry loses many of its leaves when handled. Windrowing when the hay is well wilted in the swath is necessary to prevent loss of leaves and color. The practice of baling windrowed hay is increasing thruout Illinois.

Insects and diseases. Every year red clover is damaged by insects and diseases. While an entire crop is seldom lost during the first season, the stand is likely to run out by the end of the second season.



INSECT CONTROL

Commercial Fruit Plantings

Circular 706

Forbes Scale

6/7/54

University of Illinois — College of Agriculture
Extension Service in Agriculture and Home Economics
In cooperation with Illinois State Natural History Survey

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IMPORTANT!

This circular will not be revised until 1955. So please keep your copy over the two-year period.

About the Cover . . .

Forbes and San Jose are the two most common scale insects in commercial apple and peach orchards. Highly magnified pictures on cover show difference in appearance between these two insects. The winter pruning season gives you a good chance to evaluate the scale population in your orchard and to prepare for scale control with the dormant spray (pages 12 and 24).

AUTHORS (1953): Dwight Powell, S. C. Chandler, and J. C. McDaniel of the Department of Horticulture, University of Illinois, and the Illinois State Natural History Survey. For helpful criticisms and suggestions the authors are indebted to the late C. J. Weinman, Illinois State Natural History Survey; and to H. W. Anderson, A. S. Colby, and Victor W. Kelley, Department of Horticulture.

Urbana, Illinois

February, 1953

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PEST CONTROL

In Commercial Fruit Plantings

THE BATTLE against insects, diseases, and other pests in Illinois orchards must be fought each year. In some orchards it has to be carried on in every season. To help in the fight, various experimental agencies are constantly working out better methods of pest control. This circular brings together the latest recommendations from the Illinois, Kentucky, and Indiana Experiment Stations, the Illinois Natural History Survey, and the U. S. Department of Agriculture. You may need to adjust these recommendations to suit your own conditions — *but don't experiment with untested materials and methods*. To do so may mean disaster.

Pest-control practices are so closely linked with other operations that they cannot be easily separated. This circular therefore has attempted to give recommendations necessary for quality fruit — not just adequate pest control. For efficient operation, orchard practices must be well organized. So you are urged to study the following pages carefully in order to cope better with the many problems that face you as a specialist in agriculture.

SOME BASIC STEPS IN PEST CONTROL

Continue Sanitation Practices

With the general use of organic insecticides and fungicides and with the increased cost of hand labor, many growers are omitting sanitation practices. This, however, is generally a mistake. It is practically impossible to secure a high-quality crop when one depends entirely upon chemical treatments. So if at all possible, the following practices should be observed.

For codling moth control

1. Remove all rough and loose bark from crotches, trunks, and branches during late winter or spring. Either scrape by hand or use water pressure. Directing a straight stream of water at 500 pounds pressure against the rough bark will clean a mature apple tree in at least 3 minutes.

2. Apply treated bands normally from June 10 to June 30. This will reduce the summer codling moth broods about 50 percent.
3. If possible remove all wormy fruit and destroy. Examine the top third of the tree closely at the end of the first brood.
4. Avoid mulching material coarse enough for a larva to spin a cocoon.
5. Store orchard crates and used baskets in a closed building or at least 5 miles from the orchard. Screen the packing shed if it is near the orchard. These measures keep the adult moths from returning to the orchard the next season.
6. Collect and burn all prunings and other debris. Destroy broken crates and baskets, discarded sacks, weed stems, corn stalks, etc.
7. Store props in a closed building or chemically treat them before the next season.

For disease control

1. Collect and remove infected fruit.
 2. Prune out fire blight infections as they appear, cutting 4 to 6 inches below the last point of visible infection.
 3. Remove all dropped fruit from the orchard at regular intervals.
- (For bramble sanitation see page 29; for strawberry sanitation, page 31.)

Pruning Is Very Important

Good pruning is of the greatest importance in good orcharding. A definite annual pruning program will make healthy trees.

For one thing, good pruning is an aid in sanitation. Twigs that have been killed by blight or breakage should be removed to help control frog-eye leaf spot and black rot infections. Also, fire blight infections may be reduced by pruning blighted twigs and cankers. Lateral branches should be cut back so that long tips do not extend beyond the periphery of the tree. Such tips are hard to spray and easily become infected with scab. Thus, they may be a source of spores for secondary infection.

Good pruning is a help in spraying as well as in sanitation. If branches are thinned out and the height of tall trees is reduced (Fig. 1) it is easier to get good coverage of the trees with spray material—and less spray is needed. As already suggested, cutting back lateral branches will also make spraying easier. Such pruning is especially worthwhile in orchards where spraying is done by the non-stop system. It also appears to be of utmost importance in securing maximum efficiency of concentrate sprays.

Other advantages of good pruning are that it reduces the amount of spray required for thorough coverage of each tree and cuts down fruit-thinning costs.

You can save a lot of pruning time by removing water sprouts with a gloved hand in the early summer. At this period of the year water sprouts can be rubbed off a mature tree in less than a minute. Sprouts up to 12 inches in length can be removed by this method.



Fig. 1.—Tops of high trees should be lowered for convenience in spraying and harvesting. Fruit trees should not be allowed to grow more than about 20 feet high. If trees are already too tall, cut leaders back to horizontal lateral branches (see arrows). Too-heavy cutting, exposing too much of the top to the sun, may cause branches to sun-scald. Light pruning, when the tree first begins to grow too high, is much better.

It Pays to Fertilize

Keeping fruit trees in a good state of vigor is necessary for adequate production and good fruit. Trees not in good vigor may be completely destroyed by what are normally considered minor pests. Vigorous trees, on the other hand, are far less likely to be attacked by insects and disease-producing organisms. If they are injured they will generally recover more rapidly and completely than less thrifty trees.

There are no hard-and-fast rules for fertilizing the orchard. It is, however, important to fertilize annually and to maintain a soil-fertility level high enough to support a vigorous cover crop on the orchard floor.

Many growers apply annually only nitrogen fertilizers, such as ammonium nitrate. Approximate rate is $\frac{1}{4}$ pound for every year of tree age—too much will harm the finish and color of

the fruit. Other growers use complete fertilizers, planning to apply at least 1 or 2 pounds of actual nitrogen per year to mature trees.

Fertilizers may be broadcast either over the entire orchard floor or under the trees only; or they may be spread by hand in a ring under the tree. The last of these methods is the most efficient way to supply nutrients to the tree.

Applications may be made in the fall, in the fall and the spring, or in the spring only. Some growers make summer broadcasts primarily for the cover crop, with the feeling that if the crop is healthy then the soil must be suitable for fruit trees. For most of the heavy soils in Illinois, however, late fall applications are recommended. This will permit the trees to take up the nutrients well ahead of blossoming in the spring.

Many growers are fortunate enough to have manure to supplement the commercial fertilizer program. The important thing is to fertilize regularly each year and maintain good healthy trees. *Fertilizers save money.*

Don't Neglect to Thin Your Fruit

Getting rid of surplus, defective, and low-quality fruit takes a big load off the tree. Limbs will rise, allowing better air circulation in the tree. Sprays will dry faster, and spray injury will be reduced. Besides fruit will be of better color, size, and quality, and picking costs will be lower.

A number of growers have become interested in **chemical thinning**. This method of thinning apples cannot be generally recommended at this time. Results will vary with variety, tree vigor, concentration of material used, time of application, and weather conditions. For those who want to use thinning sprays, however, the following suggestions are made for guidance.

Apples

Hormones are more practical than dinitro materials because thinning may be done after bloom, when the set can be determined and there is little danger of further thinning by late frosts.

When heavy set is expected, use naphthaleneacetic acid hormones as follows:

1. Apply at calyx or 1 week after. Fruit cracking may result on Transparent and Duchess if thinning sprays are made later than 1 week after calyx.
2. If possible, apply the chemicals as a separate spray so that the amount of material can be varied according to tree vigor and amount of bloom. Another reason for applying the thinning spray separately is that insecticides and fungicides may reduce the thinning power.
3. Apply when weather conditions are favorable for drying.
4. For Golden Delicious, Transparent, Rome, and Wealthy, use a concentration of 20 parts per million (double the strength recommended by the manufacturers for preharvest sprays).
5. For Grimes, Duchess, and York, use 15 parts per million (1½ times the concentration for preharvest sprays).
6. For Jonathan, Delicious, and Winesap, use 10 parts per million (same concentration as for preharvest sprays) at 1 week after calyx.
7. Remember that it is very easy to over-thin trees low in vigor.
8. Spray thoroughly, but do not over-spray the lower third of the tree, which is less vigorous than the upper part.

Peaches

Extensive experiments on chemical thinning of peaches were conducted in 1952. Best results were obtained by an application of naphthaleneacetic acid at a concentration of 30 parts per million 2 weeks after the shucks were off. Dry dusts were somewhat less effective than sprays. Wet dusts were somewhat more effective than sprays but also affected the foliage more.

Be Careful When Using Pesticides

Most pesticides are poisonous. Some are hazardous to the operator who prepares and applies them; some are toxic to plants; some may leave toxic residues that are dangerous to consumers; and a few are hazardous because they tend to contaminate the flavor of foods or feeds. So be sure to observe strict precautions when using pesticides.

The rapid development of new and more effective pesticides has led to greater realization of the hazards of using them, particularly on food or feed crops. Federal regulatory agencies evaluate pesticides for their toxicity — both acute and chronic — and, when necessary, establish tolerances for residues in or on foods. If residues are greater than the tolerances established, the products could be considered contaminated and therefore be subject to confiscation.

Pesticides sold in interstate commerce have been registered and labeled under federal regulations. *Read the labels.* They contain the most accurate information currently available on the specific uses and the hazards of these materials.

Recommendations are for amounts that will give a practical degree of control but at the same time keep toxicity hazards at a minimum. *Do not use more pesticide than needed and do not apply at times when dangerous residues may result.*

Parathion. Parathion is an especially deadly poison. So, although it is a highly effective insecticide for many purposes it should not be used where a safer material will give reasonably satisfactory control. Where situations demand it and you can enforce proper precautions its use may be justified.

It is essential that these precautions be followed in the use of parathion:

1. **Use only 15-percent wettable powder or 1-percent dust.**
2. **Do not use oil**, as oil increases absorption of parathion by the skin.
3. **Do not spray from the inside of the tree.**
4. **Use mask** to protect lips, nose, and mouth from accumulating residue, especially while emptying parathion sacks into the spray tanks.
5. **Stand out of the drift** when putting the powder into the tank or emptying the sacks of dust into the hopper for dusting.
6. **Do not wash the material through the screen** into the tank. Sift it in quickly with the screen removed.
7. **Do not breathe dust or powder.**
8. **Dust with the wind** and be careful of the turns at the ends of the rows. A duster or sprayer operated by one man with controls at the tractor is safer than the more common, manually operated, two-man outfit.
9. **Wash hands thoroughly** after each contact with the material and before touching the lips, eyes, etc., and before eating any food.
10. **Do not smoke** while spraying or dusting.
11. **Change clothes and bathe** at least daily. Accidentally soaked clothes should be replaced at once.

Atropine is the emergency antidote for parathion poisoning. Keep on hand a supply of atropine tablets (1/120 grain or 0.5 mg.). You will need a doctor's prescription to get them. Never take atropine or similar drugs until AFTER warning symptoms appear. Symptoms of parathion poisoning include headache, blurred vision, weakness, nausea, cramps, diarrhea, and discomfort in the chest. If you feel any symptoms while spraying with

parathion, quit spraying, take two atropine tablets at once, and go to a doctor.

If you cannot rigidly follow ALL precautions, do not use parathion.

• **Clinical test.** If you handle organic phosphate insecticides regularly, you should go to your doctor periodically for blood cholinesterase determinations.

Grasshopper Control

For several years grasshoppers have been troublesome in many orchards. Damage may occur on the foliage of young, nonbearing trees or on the fruit and foliage of bearing trees. To control this pest, use one of the following materials:

<i>Amount per acre for —</i>			
	<i>Young hoppers</i>	<i>Adult hoppers</i>	<i>Residual toxicity</i>
Chlordane.....	½ lb. actual	1 lb. actual	Excellent
Toxaphene.....	1½ lb. actual	2 lb. actual	Excellent
Benzene hexachloride.....	0.3 lb. actual gamma	0.3 lb. actual gamma	Poor
Aldrin.....	2 oz. actual	2 oz. actual	Excellent
Dieldrin.....	1 oz. actual	2 oz. actual	Excellent

Cicada Control

A brood of the 17-year race of periodical cicada (locust) will emerge in many counties of southern and eastern Illinois in 1953, and may be a serious pest this summer in some of these areas. If your orchard is in a locality where this pest was abundant in 1936, a special spray may be needed, particularly for protection of young fruit trees against damage caused by the female cicadas during egg laying.

A spray containing ¼ to ⅓ pint of 30-percent TEPP concentrate in 100 gallons of water is suggested for application in and around blocks where cicada adults are numerous. This is a contact spray, with almost no residual toxicity, so it is necessary to spray usually at night when the cicadas are at rest. Three or four applications may be needed during the period of emergence.

TEPP is an organic phosphate similar to parathion in its toxicity, and the precautions given on pages 8 and 9 for parathion should be followed when using TEPP.

Rodent Control

Rodents take a heavy toll in killed and damaged trees each year. Definite programs should be adopted for control of these pests as for insects and diseases.

A survey should be made each fall to determine whether mice are present. This can be done by walking up and down the tree rows, watching for mouse runways underneath the grass or mulch on top of the ground, and noting whether there are any small openings extending to runways underneath the soil surface. If there is evidence of mice, prepare for baiting.

During the winter, especially when snow is on the ground and food is scarce, rabbits feed on the tender bark of many kinds of young fruit trees. Protection may be secured by using a mechanical barrier (Fig. 2) or a chemical repellent.

For latest information on rodent control write to the DISTRICT AGENT, DIVISION OF PREDATOR AND RODENT CONTROL, U. S. DEPARTMENT OF INTERIOR, *West Lafayette, Indiana*.

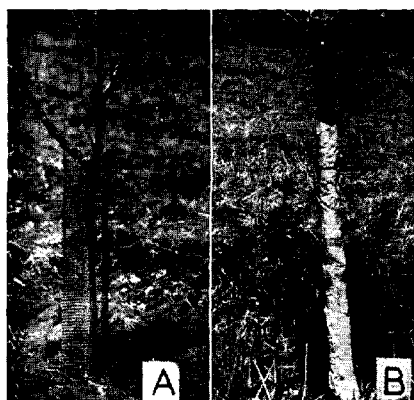


Fig. 2. — Protection of young trees against damage by rodents and insects is very important. Failure to do this, even for one season, may result in the complete loss of many trees. Galvanized gravel screen, 4 meshes per inch, placed around the trunk (A) gives protection against rodents. Wrapping paper tied around the trunk with twine (B) protects against both rodents and wood-boring insects.

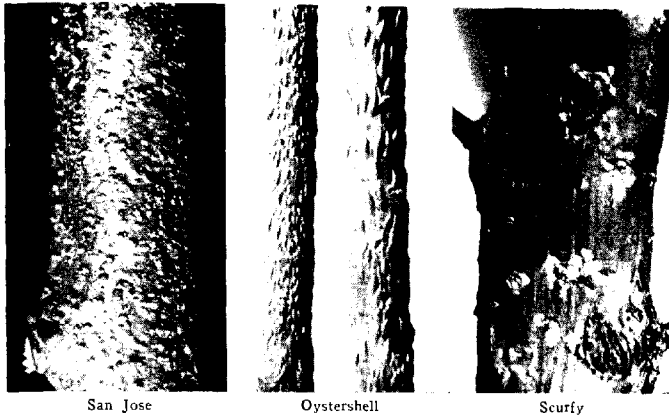


Fig. 3.—Some important scale insects in Illinois. San Jose scale is one of the most destructive pests in Illinois apple and peach orchards. Forbes scale, shown on cover, has the same general appearance as San Jose scale and is also becoming a major pest on apples and peaches. Oystershell scale is of importance only in the northern half of the state. Scurfy scale causes little damage in well-sprayed orchards.

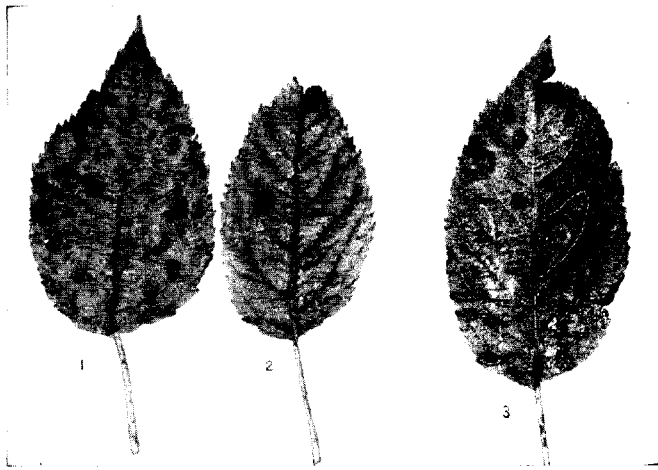


Fig. 4.—Three types of apple scab on leaves. (1) Diffused irregular spots. (2) Spots diffused but especially prominent along leaf veins. The most severe spray injury results when caustic sprays are applied to leaves showing this type of scab. (3) Well-defined spots; note also lesions on leaf stem.

SPRAY SCHEDULES FOR FALL AND WINTER APPLES

Dormant Spray

Application and purpose	Time to apply	Materials in 100 gallons of water
For all scale insects, aphids, European red mite	Before the buds are open. Early spring is safest and most effective time	Dormant oil, 3 gal. actual; DNC, 1 lb. actual
For only San Jose and Forbes scale, European red mite	.....	Dormant oil, 3 gal. actual
For green and rosy aphid	.....	DNC, 1 lb. actual
For apple scab (in problem orchards)	.....	"Elgetol" or "Krenite," ½ gal. (apply 500 gal. per acre, to ground only)

The first recommendation above is designed to destroy all insects and mites which are susceptible to chemicals during the dormant period. DNC is an abbreviation for the various dinitro sprays on the market. Other complete dormant sprays, such as "DN 289" and "Elgetol 318," are also available.

The second suggestion may be followed when aphid control is not essential. This spray will destroy the European red mite eggs and the dormant forms of San Jose and Forbes scale. It will not destroy aphid eggs or the dormant forms of oystershell and scurfy scales.

If you are concerned only with aphid control, then use the third alternative — or some other aphid spray. While DNC materials are particularly effective in destroying aphid eggs there are other good dormant sprays on the market. When only the aphid dormant is applied, keep a close watch for early-season development of scale and red mite.

The fourth suggestion is only for growers having scab trouble. Spraying the entire orchard floor will reduce scab inoculum as much as 95 percent. This spray will also make it much easier to guard against later infection.

A **delayed dormant** (Stage 2, Fig. 5) spray containing copper sulfate, 12 pounds, hydrated lime, 12 pounds, and dormant miscible oil, 2 gallons in 100 gallons of water is suggested in blocks where fire blight has been serious and where black rot and other fruit rots are troublesome.

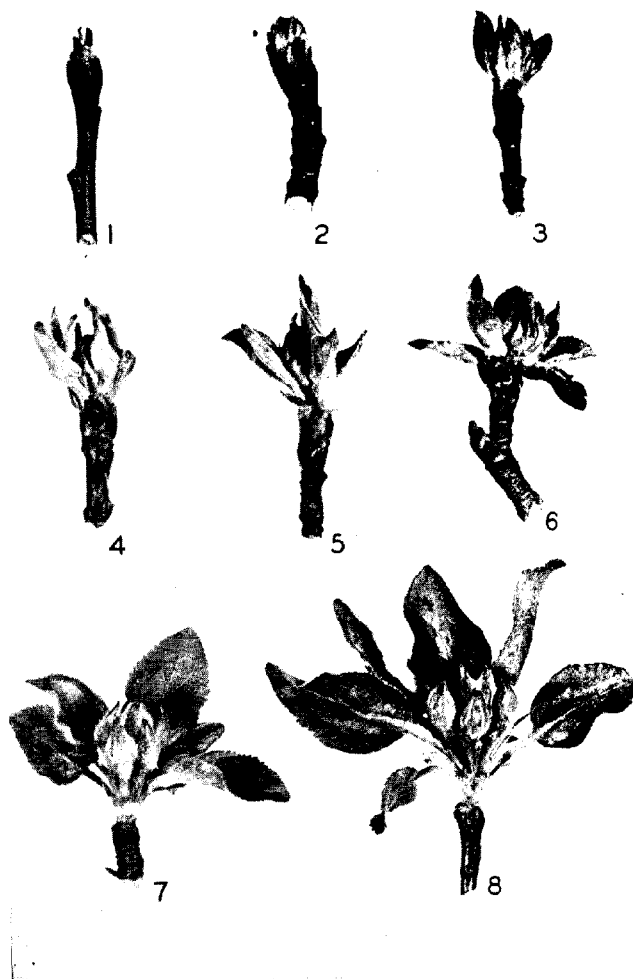


Fig. 5.—Time apple sprays with development of fruit buds. Apply the strictly dormant sprays before Stage 1. Apply delayed dormant sprays during Stage 2. Apply prepink spray between Stages 3 and 6. Start the pink spray at Stage 7 (not later than 8), and complete by the time the first flowers open.

Prepink Spray

Application and purpose	Time to apply	Materials in 100 gallons of water
For apple scab	Before flower buds show pink (<i>Fig. 5, Stages 3 through 5</i>)	Liquid lime sulfur, 2 gal. — or — Dry lime sulfur, 8 lb. — or — Organic mercury compound

Apple scab is still the most serious apple disease. Lime sulfur, either dry or liquid, is suggested for this spray because it is readily available and more economical than other materials. It is important to spray the foliage as soon as the buds break open exposing the new leaves. Organic mercury compounds are very efficient in controlling scab. Many growers are using them where sulfur has not been too effective. These materials will definitely eradicate scab and can be applied after infection has occurred, or after a rainy period.

The prepink application is one of the most important sprays on fall and winter varieties because if scab is to be controlled it must not be allowed to get started. More than one prepink application is necessary when weather is cold and rainy.

Sulfur dusts may be used to supplement the sprays.

Two apple tree borers may cause very serious injury on trees up to about 12 years of age in Illinois.

The roundheaded apple tree borer is found mostly in the northern two-thirds of Illinois. It usually burrows in the base of the trunk, anywhere from 2 inches below the ground to a foot or more above. Heavy DDT sprays are being tested on this borer. They cannot yet be recommended, but anyone wanting to try them can get information from the Illinois State Natural History Survey, Urbana.

The flatheaded apple tree borer works higher on the trunk and sometimes infests the branches. It nearly always locates on the sunny side of a tree, but may be found on all sides. Weakened trees are especially susceptible. Shading the trunk gives some control. Either wrap it or put two boards, nailed together to form a trough, near the south and west sides. Best protection is to keep trees vigorous.

Pink or Cluster-bud Spray

Application and purpose	Time to apply	Materials in 100 gallons of water
For apple scab	When most of the buds in the cluster have separated (<i>Fig. 5, Stages 7 and 8</i>)	Same as prepink or Microfine sulfur, 8 lb.
If red-banded leaf roller is serious	.....	TDE, 1 lb. actual added to above spray
If aphids are serious	.....	15% parathion, 1 lb. added to above spray (<i>see pages 8 and 9 for precautions</i>)
If curculio is serious	.....	Dieldrin, 1/4 lb. actual added to above spray

This spray is primarily for apple-scab control. Lime sulfur may be used on certain varieties, but it is not recommended for Golden Delicious or Jonathan because it may injure them. Microfine sulfur, however, is safe on these varieties. Microfine sulfur includes the many commercial brands of wettable sulfurs such as the pastes or the dry forms having particles with an average diameter of 2 to 10 microns. The organic mercury materials are excellent for this spray and are highly recommended in place of sulfur if the additional cost is not a factor. **Sulfur dusts may be used as supplements to whatever spray is used.**

Other pests which may appear at this stage of tree development are aphids, red-banded leaf roller, and curculio. If all three pests need control parathion should be added to whatever fungicide is used. If only red-banded leaf roller is present TDE should be used because it is more effective than parathion for leaf roller and is less dangerous to handle. If you have been having trouble with curculio, use the dieldrin spray, which also is much safer to use than parathion and which is specifically toxic to curculio.

Bloom Spray

Application and purpose	Time to apply	Materials in 100 gallons of water
(DO NOT USE LEAD ARSENATE OR OTHER POISONS IN THIS SPRAY)		
For apple scab, cedar and quince rust	When 20% of blossoms have opened	Microfine sulfur, 3 lb. 70% ferbam, $\frac{1}{2}$ lb.
For fire blight	2 sprays 4 days apart starting when 10% of blossoms are open	Copper sulfate, 1 lb. Hydrated lime, 3 lb.

In most seasons the cedar galls start discharging spores at the same time that apple trees are beginning to bloom. If problem blocks are not sprayed at this time, they usually give trouble later. For, while ferbam applied as a bloom spray is especially effective in controlling the rust diseases, it cannot be relied upon to stop an infection after it has once got a good start. If rust is not a problem and cool weather prolongs the blooming period, sulfur with or without ferbam, or the organic mercury materials may be used for scab control.

Fire blight control is still a big problem. The Bordeaux spray suggested in the table will reduce blight infection but will not always give adequate control. Seventy-five percent zineb, 2 pounds in 100 gallons of water, has shown some promise in reducing blight infection and is less injurious than the Bordeaux mixture. It is more expensive than Bordeaux, however, and is still considered experimental. If blight-control measures are used in any block then the other sprays suggested for rust and scab control are not needed.

Calyx Spray

Application and purpose	Time to apply	Materials in 100 gallons of water
For codling moth, apple scab, curculio, red-banded leaf roller, cedar and quince rust	When $\frac{3}{4}$ of petals have fallen (<i>see Figs. 6 and 7</i>)	Lead arsenate, 3 lb. 70% ferbam, $\frac{1}{2}$ lb. Microfine sulfur, 3 lb.
If red-banded leaf roller is serious	.....	TDE, 1 lb. actual added to above spray
If curculio is serious	.....	Dieldrin, $\frac{1}{4}$ lb. actual added to above spray

The better growers still use lead arsenate in the calyx spray. Ferbam and sulfur are adequate for disease control and are particularly

desirable on varieties susceptible to cedar and quince rust. The organic mercuries may be substituted for the ferbam and sulfur for scab control. Lime is not necessary to correct arsenical injury when ferbam or the organic mercury compounds are used as the fungicide.

A new chemical known as captan is suggested as a substitute fungicide on Golden Delicious and on varieties susceptible to fruit russet. Fifty-percent captan, 2 pounds in 100 gallons, has proved to be an excellent fungicide. Captan may be used in combination with lead arsenate without an additional safening agent. Since captan is still more expensive than other commonly used fungicides, its use should be limited to problem blocks.

When time permits, special top-off sprays are suggested after this and the following sprays. Use the same materials and apply to the top third of the tree immediately after the regular spray.



Fig. 6. (*above*).—Time to apply calyx spray for scab and codling moth. Petals have just fallen but calyx lobes are still open.



Fig. 7 (*right*).—Too late for calyx spray. Calyx lobes have closed.

First Cover Spray

Application and purpose	Time to apply	Materials in 100 gallons of water
For curculio, codling moth, scab, blotch, rust, and leaf roller	7 days after the last spray	Lead arsenate, 3 lb. 70% ferbam, 1 lb.
If curculio is serious	.....	Dieldrin, $\frac{1}{4}$ lb. actual added to above spray
If red-banded leaf roller is serious	.....	TDE, 1 lb. actual added to above spray

If lead arsenate is used in this spray, red-banded leaf roller should not become too serious. Occasionally, however, a more effective material such as TDE is necessary. European red mite may start to build up at this time, especially where satisfactory control was not achieved in the dormant stage. If so, use a suitable mite spray, but do not use parathion as it may injure the fruit. Continue with captan, 2 pounds in 100 gallons of water, on Golden Delicious in place of ferbam if it is desired.

CONCENTRATE SPRAYING has saved time, labor, and materials for a good many orchard men. The theory is to use as much chemical per tree as in the standard schedules, but less water. For example, a standard recommendation for DDT might be 1 pound actual to 100 gallons. With a conventional sprayer, about 600 gallons of this mixture would be needed for an acre of orchard 25 to 30 years old. If the spray were concentrated 3 times, then 3 pounds actual of DDT would be used to 100 gallons of water, and 200 gallons would be used for an acre of orchard. Either way, 6 pounds of DDT would be applied per acre.

Tests have been conducted with as high as 10 to 12 times the normal concentration. Thus far, however, it appears that 2 to 4 times is the most practical concentration for efficient control of orchard insects and diseases.

At present, specialized equipment such as the speed sprayer, mist blower, or liquid duster is used for concentrate applications. See your dealer for the types of nozzles to use.

Second and Third Cover Sprays

Application and purpose	Time to apply	Materials in 100 gallons of water
For curenlio, codling moth, red-banded leaf roller, leaf hopper, scab, and blotch	<i>2d cover</i> , approximately 7 days after 1st cover (see spray service report)	Lead arsenate, 2 lb. 50% DDT, 1 lb. — plus either — 70% ferbam, 1 lb. — or — Crag 341, 1 qt. — or — 50% captan, 1 lb.
	<i>3d cover</i> , 10 days after 2d cover	

The second cover is one of the most important sprays for codling-moth control because at this time of year the first egg hatch occurs and the young larvae attack the fruit. It is important to cover the apples thoroughly before egg hatch starts. Parathion should not be added to this spray because of possible fruit injury.

If you have not been entirely satisfied with ferbam, try Crag fruit fungicide 341 instead. It is an excellent fungicide and will keep such diseases as late scab, sooty blotch, fly speck, and frog-eye leaf spot to a minimum. For excellent finish on Golden Delicious, or for bitter-rot control, the captan schedule is suggested.

Watch for mite development and include a mite spray (page 20) in this application if necessary. If leaf rollers continue to be troublesome, add TDE, 1 pound actual in 100 gallons, to this spray.

Fourth and Fifth Cover Sprays

Application and purpose	Time to apply	Materials in 100 gallons of water
For codling moth, mites, bitter rot, scale, and apple maggot	<i>4th cover</i> , 10 days after 3d cover	50% DDT, 2 lb. — or — 15% parathion, 2 lb. — plus either — 70% ferbam, 1½ lb. — or — 50% captan, 1 lb. — or — Crag 341, 1 qt.
	<i>5th cover</i> , 14 days after 4th cover	

For insect control, either DDT or parathion may be used in these sprays. If parathion is used for mite control, apply it at least twice

at 7-day intervals. This really means an extra spray between the fourth and fifth cover. For insect pests this extra spray is not needed. Parathion is one of the few materials that will destroy a codling moth larva just after it has entered the apple. The material is extremely dangerous to use, so follow the precautions listed on pages 8 and 9. Captan should be used only on Golden Delicious or in bitter-rot blocks until it is more readily available. Lead arsenate should not be used in these or in succeeding sprays because of residue problems. If mites are a problem, and parathion hasn't been used or hasn't given good control, consult the following table for suggestions.

Material	Amount in 100 gallons of water	No. of sprays necessary	Lasting effect	Toxicity to operator
"Aramite"	1½ to 2 lb.	1 or 2	3 to 4 weeks	None
"EPN"	¾ lb.	2 or 3	10 to 14 days	High
"Dimite"	1 pt.	1 or 2	3 to 4 weeks	None
"Ovatran"	½ lb.	3 successive sprays 7 days apart	4 to 6 weeks	Low

Special sprays. Except in northern Illinois, special sprays for bitter-rot control may be needed at this time in blocks which have not had previous attention. Use 50-percent captan, 2 pounds in 100 gallons of water in 2 sprays — the first about 7 days after the fifth cover and the second 10 days later.

Second- and third-brood codling moth sprays should start about 3 weeks after the fifth cover spray. Make 2 or 3 applications of either 50-percent DDT, 2 pounds, or 15-percent parathion, 2 pounds in 100 gallons of water, at 10- to 12-day intervals. See the spray service report for more exact timing. Watch for mite development. Also, red-banded leaf roller may start damage to the fruit at this time. If so use TDE, 1 pound actual in 100 gallons.

SUMMER APPLES

Spray Schedule

(For dormant applications use those listed for fall and winter varieties.)

Application and purpose	Time to apply	Materials in 100 gallons of water
Delayed dormant , for blotch in heavily infected orchards	As late as possible, before too many leaves appear (Fig. 3, Stage 2)	Copper sulfate, 12 lb. Hydrated lime, 12 lb. Miscible dormant oil, 2 gal.
Prebloom , for scab and curculio	When buds show pink	70% ferbam, 2 lb. Dieldrin, $\frac{1}{4}$ lb. actual
Bloom , for fire blight	2 sprays 4 days apart starting when 10% of blossoms are open	Copper sulfate, 1 lb. Hydrated lime, 3 lb.
Calyx , for scab, blotch, codling moth, and curculio	When $\frac{3}{4}$ of petals have fallen	Lead arsenate, 3 lb. 70% ferbam, $\frac{1}{2}$ lb. Dieldrin, $\frac{1}{4}$ lb. actual
1st cover , for codling moth, curculio, scab and blotch	7 days after calyx	Same as for calyx
2d cover , for codling moth, blotch and scab	10 days after 1st cover	Same as for calyx but omit dieldrin
3d cover , ^a for codling moth	10 days after 2d cover	50% DDT, 2 lb. — or — 15% parathion, 2 lb. — or — Black leaf 155, 3 lb. Summer oil, 2 qt.

^a A fourth cover is needed in some years for the second-brood codling moth. If necessary, use the Black leaf 155 and oil spray suggested for the third cover.

A simple way to figure amount of non-concentrate spray for apple trees: For dormant and prepink sprays, divide age of tree by 4 to find gallons needed per tree. For pink spray, divide by 3; for calyx, divide by 2; for succeeding sprays, divide by 1.5. Example: a 10-year-old tree should be given the following amounts:

Dormant and prepink stages 2.5 gallons
Pink stage 3.3 gallons
Calyx stage 5.0 gallons
Each succeeding spray 6.7 gallons



Fig. 8.—PDB treatment for peach borers consists of a “death ring” of paradichlorobenzene crystals (*left*) placed close to the trunk of the tree *but not touching the bark*. The ring of crystals is covered with a mound of earth (*right*) to confine the gas. (If you cannot obtain PDB, write to the ILLINOIS NATURAL HISTORY SURVEY, Urbana, Illinois, for directions for using ethylene dichloride.)

PEACHES AND APRICOTS

Borer Control

The *peach tree borer* attacks plums, cherries, and nectarines, as well as peaches and apricots. It works at the base of the tree and if not controlled annually will kill the tree. Best control method is to apply 50-percent DDT (6 pounds to 100 gallons of water) from the crotch to the base of the trunk. Starting about July 8, apply three such sprays 3 weeks apart.

Crystalline paradichlorobenzene (PDB) will also give reasonably good control. Apply it to the ground in a ring around the tree — just far enough away that it does not touch the bark — then cover it with 3 to 5 spadefuls of earth (Fig. 8). Use these amounts of PDB:

Trees 1 year old, $\frac{1}{4}$ oz.

Trees 2 years old, $\frac{1}{2}$ oz.

Trees 3 to 5 years old, $\frac{3}{4}$ oz.

Trees 6 to 10 years old, 1 oz.

Trees older than 10 years,

1 to 2 oz.

Fall treatments are more effective than spring treatments. Soil temperature should be 55° F. or over to volatilize the material. In general, the best dates for treatment are from September 25 to October 15, depending on latitude and soil temperatures.

The *lesser peach tree borer* works higher on the trunk or in crotches and injured places over the tree. It can be controlled with 15-percent parathion, 3 pounds in 100 gallons of water. Make four applications 3 weeks apart, starting in mid-June. This treatment may also be used instead of DDT on the peach tree borer. PDB-oil is reasonably effective against the lesser peach tree borer. Paint affected

areas with 2 pounds of PDB crystals dissolved in 1 gallon of miscible oil, and made up to 2 gallons with water.

Bark beetles usually attack only weakened trees or branches, though occasionally they are found on healthy trees. Usually they can be controlled by increasing the vigor of the tree by means of fertilizers, proper drainage, or scale control. Frequently a heavy application of nitrogenous fertilizer corrects the trouble because the grubs generally do not thrive on fast-growing wood.

The treatments described for the lesser peach tree borer are also moderately effective in controlling bark beetles.

Virus Diseases of Peaches

Peach yellows, peach rosette, phony peach, and yellow-red virosis are virus diseases of peaches known to have been present in Illinois during recent years.

Peach yellows is often harbored in the plum, where the symptoms are inconspicuous. For this reason wild plums should not be left growing near peach orchards. The yellow-red virosis is primarily a disease of chokecherry, but it may spread to peaches. So all chokecherries within half a mile of peach orchards should be destroyed. Common wild black cherry does not carry this virus.

If virus diseases are suspected, write the STATE NURSERY INSPECTION SERVICE, Glen Ellyn, Illinois, for an inspection.

Jarring peach and apricot trees is the only good way to get information on the abundance of "catfacing" insects — the plum curculio, tarnished plant bug, and certain of the stink bugs (penatomids) — in the orchard.

A sudden jar of the main framework branches will make the insects fall to a sheet spread beneath the tree. They usually "play possum" long enough to be counted. Make a count on five trees — one in each of the five rows closest to the edge of the orchard (usually the insects are most numerous near the edges, especially if the orchard borders a woods). The count indicates the general insect population of the orchard and aids in deciding when to spray and how much insecticide to use. Jar the same trees once a week, keeping a record of the number of curculio and other insects collected.

Standard Spray Schedule for Peaches and Apricots

Application and purpose	Time to apply	Materials in 100 gallons of water
Dormant — for San Jose and Forbes scale, European red mite, leaf curl	In spring before the buds swell	Dormant oil, 3 gal. actual Copper sulfate, 4 lb. Hydrated lime, 3 lb.
— for scale and mites only	.....	Dormant oil, 3 gal. actual
— for leaf curl only	.....	Copper sulfate, 4 lb. Hydrated lime, 3 lb. — or — Liquid lime sulfur, 5 gal.
Early bloom , for brown rot, blossom blight, catfacing insects	When 5% of blossoms are open	50% DDT, 2 lb. Microfine sulfur, 3 lb. "Phygon XL," ¼ lb.
Full bloom , for blossom blight, catfacing insects, curculio	Full bloom	Dieldrin, ¼ lb. actual Microfine sulfur, 3 lb. "Phygon XL," ¼ lb.
Shuck-split , for curculio, brown rot, catfacing insects	When ¼ of shucks are splitting	Dieldrin, ¼ lb. actual Microfine sulfur, 6 lb.
1st cover , for curculio, scab	10 days after shuck-split	Same as shuck-split
2d cover , for curculio, scab	10 days after 1st cover	Microfine sulfur, 6 lb. — plus either — 15% parathion, 2 lb. (see page 8) — or — Chlordane, 1 lb. actual ^a
3d cover , for curculio, oriental fruit moth, scab, and brown rot	10 days after 2d cover	Microfine sulfur, 6 lb. — plus either — 15% parathion, 2 lb. — or — Chlordane, 1 lb. actual ^a 50% DDT, 2 lb.
4th cover , for oriental fruit moth	7 days after 3d cover	15% parathion, 2 lb. — or — 50% DDT, 2 lb.
5th cover , for curculio, oriental fruit moth, brown rot	1 month before harvest	Microfine sulfur, 6 lb. — plus either — 15% parathion, 2 lb. — or — Chlordane, 1 lb. actual ^a 50% DDT, 2 lb.
— If leaf rollers are present	.....	TDE, 1 lb. actual, added to above materials
6th, 7th, and 8th covers , for brown rot	21, 14, and 7 days before harvest	Microfine sulfur, 8 lb. — or — 50% captan, 2 lb.

^a Injury has been reported on *apricot* trees from the use of chlordane.

Dust Schedule for Peaches and Apricots

(For dormant application see standard spray schedule, page 24.)

Application and purpose	Time to apply	Dust formulas
Early bloom , for catfacing insects, blossom blight	When 5% of blossoms are open	Commercial DDT-sulfur dust (preferably containing "Phygon")
Full bloom , for curculio, catfacing insects, brown rot	Full bloom ^a	Commercial benzene hexachloride dust (<i>see footnote b</i>) — or — Commercial parathion dust (<i>see footnote c</i>)
Shuck-split , for curculio, catfacing insects, brown rot	When shucks begin to crack	Same as for petal fall
1st cover , for curculio and scab	When shucks are $\frac{2}{3}$ off fruit	Same as for petal fall (<i>see footnote d</i>)
2d cover , for curculio and scab	7 days after 1st cover	Same as for petal fall
3d cover , for curculio and scab	7 days after 2d cover	Same as for petal fall
4th cover , for curculio	7 days after 3d cover	Same as for petal fall
5th, 6th, and 7th covers , for curculio and oriental fruit moth	At 7-day intervals after 4th cover. (<i>See spray service report for oriental fruit moth emergence</i>)	Same as for petal fall plus addition of 5% DDT if not using parathion
8th cover , for curculio, oriental fruit moth, and brown rot	One month before harvest	Same as for 5th, 6th, and 7th covers (<i>see footnote d</i>)
9th and 10th covers , for brown rot	At 15 and 7 days before harvest	Sulfur-oil dust (<i>see footnote e</i>)

^a If blooming period is prolonged, make a second application after petal fall.

^b Commercial benzene hexachloride dust should contain approximately the following ingredients: benzene hexachloride, 1.0 percent gamma; sulfur, 50 percent; oil, 5 percent; inert ingredients, 44 percent.

^c A 1-percent parathion dust with sulfur has been extremely promising in tests on peaches but is highly dangerous and **should not be used unless all precautions are followed**. Parathion is safest when applied with a liquid duster. **Do not dust when the wind will carry the material into nearby residences.** For other precautions, see pages 8 and 9.

^d If red-banded leaf rollers appear spray with TDE, 1 lb. actual to 100 gallons of water.

^e Sulfur-oil dust should contain approximately the following ingredients: sulfur, 65 percent; lime, 15 percent; talc, 15 percent; oil, 5 percent.

SPRAY SCHEDULE FOR PEARS

Application and purpose	Time to apply	Materials in 100 gallons of water
Dormant , for pear psylla and scale	Before buds begin to open. Not needed every year	Dormant oil, 3 gals.
Bloom , for fire blight	2 sprays 4 days apart starting when 10% of blooms are open	Copper sulfate, 1 lb. Hydrated lime, 3 lb.
Calyx , for codling moth, curculio, leaf spot, and pear scab	As soon as petals have fallen	Lead arsenate, 3 lb. Hydrated lime, 3 lb. Microfine sulfur, 8 lb. — or — Lead arsenate, 3 lb. 70% ferbam, 1½ lb. Soybean flour, ¼ lb.
1st cover , for codling moth, curculio, leaf spot, and pear scab	10 to 12 days after calyx spray	Same as for calyx
2d cover , for codling moth, leaf spot, and scab	14 days after 1st cover	Lead arsenate, 3 lb. 70% ferbam, 1 lb.
3d cover , for codling moth, leaf spot, and scab	14 days after 2d cover	Lead arsenate, 3 lb. Copper sulfate, 1 lb. Hydrated lime, 2 lb. Summer oil, 2 qt.
Additional sprays		
— for codling moth and leaf spot.....	Same as for 2d-brood codling moth on apple, if necessary	Same as for 3d cover
— for psylla.....	When nymphs are visible on water sprouts	Copper sulfate, 2 lb. Hydrated lime, 4 lb. Summer oil, 6 qt. — or — 15% parathion, 2 lb. (see pages 8 and 9 for precautions)

PLUMS

Plums are subject to only two virus diseases, *rosette* and *yellow*s. The only way to control these diseases is to remove all infected trees promptly.

Black knot, a fungus disease, may be controlled by removing and burning, for two successive years, all twigs showing knots during the winter months. On large limbs the knots may be cut out, thus saving the limbs. Spraying is sometimes helpful. A delayed dormant spray made of copper sulfate, 12 pounds; hydrated lime, 12 pounds; and miscible dormant oil, 2 gallons, for each 100 gallons of water should be applied as buds begin to swell. On infected trees follow this delayed dormant spray with liquid lime sulfur, using 2 gallons in 100 gallons of water for the first and second cover sprays (this will take the place of the recommended copper sulfate-hydrated lime spray).

Spray Schedule for Plums

Application and purpose	Time to apply	Materials in 100 gallons of water
Dormant , for scale insects	Before buds begin to open	Dormant oil, 3 gal.
1st cover , for curculio	Right after shucks have fallen	Lead arsenate, 3 lb. Copper sulfate, 1 lb. Hydrated lime, 2 lb. Summer oil, 1 qt.
2d cover , for curculio	10 days after 1st cover	Same as for 1st cover
Additional covers		
— for brown rot	At weekly intervals starting 3 weeks before harvest	Microfine wettable sulfur, 8 lb.
— for aphids	Apply when needed	Soap flakes, 4 lb. Nicotine sulfate (40%), 1 pt.

For borer control see page 22, peach tree borer.

SPRAY SCHEDULE FOR CHERRIES

Application and purpose	Time to apply	Materials in 100 gallons of water
Dormant, for Forbes scale	Before buds begin to open	Dormant oil, 3 gal.
Ground spray, for leaf spot	In early spring before buds begin to open. Apply to ground only. Use 500 gal. per acre	"Elgetol," $\frac{1}{2}$ gal.
1st cover, for brown rot, leaf spot, curculio, and slug	Right after shucks have fallen	Lead arsenate, 3 lb. — plus either — 70% ferbam, $1\frac{1}{2}$ lb. — or — Crag 341, 1 qt. Hydrated lime, $\frac{1}{2}$ lb.
2d cover, for same pests as 1st cover	10 days after 1st cover	Same as for 1st cover
Additional sprays		
— for leaf spot.....	Right after harvest	Crag 341, 1 qt. — or — 70% ferbam, $1\frac{1}{2}$ lb.
— for cherry slugs.....	In August	Lead arsenate, 2 lb. Hydrated lime, 6 lb.

Thorough Spraying Is Essential for All Fruits

Use adequate pressure. Do not rely on measurements of pressure gages after two or more seasons of service — have the gages checked.

Select disks with correct openings and replace worn disks. Be sure the disks will carry the maximum load. A 35-gallon pump should discharge at least 30 gallons a minute during full operation.

Spray tops of trees with special care. Equip the spray rig with a tower. Apply top-off sprays when recommended.

Examine fruit and leaves frequently. Look for evidence of disease and insect injury. See whether spray coverage is complete, especially in tops of trees.

Apply enough spray. And remember that one good spray is worth more than two poor ones.

BRAMBLES

Sanitation

Certain diseases of brambles such as *crown gall*, *orange rust*, *mosaic*, *leaf curl*, and *bramble streak* cannot be controlled by spraying. The following practices are recommended to aid in preventing these diseases:

- (1) Do not replant on a site where diseased plants have been recently grown.
- (2) Select resistant varieties.
- (3) Order planting stock from a reliable nursery.
- (4) Have plantings of red and black raspberries as much as 300 feet apart.
- (5) As soon as diseased plants are detected, dig them up with as many of their roots as possible, and burn at once.
- (6) At planting time cut off old stubs of 2-year-old nursery stock and "handles" of young purple and black raspberries.
- (7) Remove and burn old fruiting canes immediately after harvest.

For a full discussion of selection of varieties and cultural methods, see Illinois Circular 508, "Bramble Fruits."

Spray Schedule for Brambles

Application and purpose	Time to apply	Materials in 100 gallons of water
Delayed dormant , for anthracnose, spur blight, mites, and rose scale	In spring after growth has started but preferably before leaflets are $\frac{3}{8}$ in. long	Liquid lime sulfur, 11 gal. — or — Dormant oil, 3 gal. Copper sulfate, 8 lb. Hydrated lime, 8 lb.
Cover sprays , for anthracnose, spur blight	Every 7 to 10 days after delayed dormant until prebloom	70% ferbam, 1½ lb.
Prebloom , for anthracnose	Immediately before bloom	Same as for cover sprays
— If fruit worms or sawfly larvae are present	.....	Lead arsenate, 2 lb., added to above spray
Postbloom , for anthracnose	Immediately after bloom	Same as for cover sprays
Special sprays , for mites	June and early July	See page 29
Post-harvest spray , for anthracnose and Septoria leaf spots and mites	Immediately after harvest	70% ferbam, 1½ lb. Summer oil, 1 gal.
— If mites are serious	.....	See page 29

CURRANTS, GOOSEBERRIES, GRAPES

Spray Schedule for Currants and Gooseberries

Application and purpose	Time to apply	Materials in 100 gallons of water
Dormant , for scale insects	Before growth starts	Dormant oil, 2 gal.
1st cover , for currant aphids and leaf spot	When leaves start to unfold	Copper sulfate, 4 lb. Hydrated lime, 6 lb. Nicotine sulfate (40%), 1 pt.
2d cover , for currant worm and leaf spot	When in full foliage; do not wait for worms to appear	Copper sulfate, 4 lb.* Hydrated lime, 6 lb. Lead arsenate, 2 lb.
Additional covers		
— for leaf spot.....	2 sprays 2 weeks apart, following 2d cover	Same as for 2d cover except omit lead arsenate
— for worms feeding on plants in fruit.....	As needed	Rotenone garden dust or spray (<i>comparatively non-poisonous to man</i>)

Spray Schedule for Grapes^a

Application and purpose	Time to apply	Materials in 100 gallons of water
Dormant , for scale and anthracnose	Before buds open (<i>seldom needed</i>)	Commercial liquid lime sulfur, 7 gal.
1st cover , for black rot and grape flea beetle	When new growth is 2 to 4 inches long	DDT, 1 lb. actual ^b 70% ferbam, 1½ lb. Soybean flour, ¼ lb.
2d cover , for grape berry moth, rose chafer, black rot, and anthracnose	Just before the bloom	DDT, 1½ lb. actual ^b 70% ferbam, 1½ lb. Soybean flour, ¼ lb.
3d cover , for grape leafhopper, grape leaf folder, grape root worm, rose chafer, black rot, anthracnose, and downy mildew	After bloom, when berries are set	Same as for 2d cover ^c
4th cover , for leafhopper, black rot, anthracnose, ripe rot, mildews	3 weeks after 3d cover	Same as for 2d cover

^a This schedule is based on the supposition that each application will use approximately 250 gallons of spray per acre.

^b If grape mealybug is serious substitute 2 pounds of 15-percent parathion for the DDT.

^c If mildew infection develops substitute one of the insoluble copper sprays for the ferbam.

STRAWBERRIES

Sanitation

Diseases and insects of strawberries can usually be controlled by cultural and sanitary methods. The following practices are recommended:

(1) To avoid white grubs, do not plant strawberries on sod-land until it has been under cultivation for at least two years. (2) To reduce crown borer injury, separate new beds at least 350 yards from old beds and plow up the patch after two picking seasons. (3) Choose varieties resistant to disease in so far as possible. For example, in areas where red stele root rot is common, plant varieties resistant to this disease. (4) Renovate beds immediately after each harvest.

For a full discussion of cultural and sanitation methods for strawberries, see Illinois Circular 453, "Strawberry Culture in Illinois," (revised in 1953).

Spray Schedule for Strawberries

Application and purpose	Time to apply	Materials in 100 gallons of water
1st cover , for leaf spot, leaf roller, gray mold, weevil, and buttoning pests	First appearance of blossoms	Chlordane, $\frac{1}{2}$ lb. actual 50% DDT, 1 lb. — plus either — 50% captan, 2 lb. — or — 70% ferbam, 2 lb.
2d cover , for same pests as 1st cover	10 days after 1st cover	Same as 1st cover
3d cover , for gray mold	10 days after 2d cover	50% captan, 2 lb. — or — 70% ferbam, 2 lb.

A dust containing 5-percent DDT, 5-percent chlordane, and either 10-percent ferbam or captan is recommended for control of strawberry insects and diseases. Apply 30 pounds per acre when blooms first appear and again in 10 days. A third dust containing only ferbam or captan would help to control gray mold.

IDENTIFICATION AND COMPATIBILITY OF PESTICIDES

Key for Identifying New Organic Materials

Common name, brand name ^a or abbreviation	Chemical	Use
Aldrin	Hexachloro-hexahydro-dimethanonaphthalene	Grasshoppers; curculio (experimental)
"Aramite"	Beta-chloroethyl-beta-(paratertiary butylphenoxy)-alpha-methylethylsulfite	Mites
BHC	Benzene hexachloride	Curculio, grasshoppers
Captan	N-trichloromethyl-thiotetrahydro-phthalamide	General fungicide
Chlordane	Octachloro-methano-tetrahydroindane	Curculio, catfacing insects, grasshoppers
"Crag 341"	Heptadecyl glyoxalidine	Apple scab, cherry leaf spot, brown rot
2, 4-D	2, 4-dichlorophenoxyacetic acid	Weed killer
DD	1, 2-dichloropropane and 1, 3-dichloropropylene	Soil fumigant
DDT	Dichloro-diphenyl-trichloroethane	Codling moth, leafhoppers, oriental fruit moth, catfacing insects
Dieldrin	Hexachloro-epoxy-octahydro-dimethanonaphthalene	Curculio (experimental)
"Dimite"	Di(parachlorophenyl)methylcarbinol	Mites
"DN 111"	Dicyclohexylamine salt of 2, 4-dinitro-o-cyclohexyphenol	Mites; sooty blotch (experimental)
"DN 289"	Dinitro-o-sec-butylphenol	Dormant spray for mites, scale, and aphids
DNC	Dinitro-o-cresol	Scale, aphids on apple
"Elgetol"	Sodium dinitro-o-cresylate	Scale, aphids on apple
"Elgetol 318" (See "DN 289")		Apple scab ground spray
Ferbam	Ferric dimethyldithiocarbamate	Apple scab, blotch, cedar rust
"Krenite" (See "Elgetol")		
Lindane	Gamma isomer of benzene hexachloride	Curculio, grasshoppers
Parathion	o-diethyl-p-nitrophenyl thionophosphate	Mites, codling moth, scale curculio, etc.
PDB	Paradichlorobenzene	Peach tree borer
"Phygon XL"	2,3-dichloro-1, 4-naphthoquinone	Peach blossom blight, apple scab
"Puritized Agricultural Spray"	Phenylmercuric triethanol ammonium lactate	Apple scab
"Puritized Apple Spray"	Phenylmercuric monoethanol ammonium acetate	Apple scab
"Tag 331"	Phenyl mercury acetate	Apple scab
TDE	Dichloro-diphenyl-dichloroethane	Red-banded leaf roller
TEPP	Tetraethyl pyrophosphate	Mites, cicadas
Toxaphene	Chlorinated camphene	Grasshoppers
Zineb	Zinc ethylene bis-dithiocarbamate	Fire blight, apple scab

^a Brand names (in quotation marks) have been used only when necessary to clarify the existing confusion concerning the identity of these chemicals.

Compatibility Chart for Orchard Insecticides and Fungicides

	Aromatic	BHC	Bordeaux mixture	Capton	Chlordane	Croq 341	DDT and Dieldrin	Dimite	DN 111	DN 289	DNC	Domion oil	EPN 200	Ferbion	Hydrated lime	Lead arsenate	Lime sulfur	Nicotine sprays	Organic mercury	Parathion	Phygon XL	Sulfur	Summer oil	TDE	TEPP	Znab
X																										
—	•																									
•	X	—																								
X	X	•	X																							
—	•	X	—	•																						
X	X	•	X	X	•																					
0	X	X	X	X	X	X																				
X	X	—	0	X	—	X	0																			
0	0	0	0	0	0	0	0	0																		
0	0	—	0	X	—	X	0	0	X																	
0	0	X	0	0	0	0	0	—	X																	
0	X	•	X	X	•	X	X	X	0	0	0															
X	X	—	X	X	X	X	X	0	0	0	X															
—	•	X	—	•	X	•	X	—	—	X	•	—														
X	X	X	X	X	X	X	X	X	0	0	0	X	X	X												
—	•	—	•	•	X	•	—	0	—	—	X	X														
X	•	•	X	•	X	•	X	0	0	0	X	•	X	•												
0	X	—	0	X	0	X	0	—	0	0	0	—	0	—	X	—										
X	X	•	X	X	•	X	X	X	0	0	0	X	X	•	X	—	•	X								
X	X	—	0	X	X	X	—	0	0	0	X	—	X	—	0	X										
X	X	X	X	X	X	X	X	0	0	0	X	X	X	X	X	X	X									
X	X	X	—	—	X	X	—	0	0	0	0	X	X	X	—	X	—	0	—							
X	X	•	X	X	•	X	X	0	0	0	X	X	•	X	•	•	X	X	X	X	X	X	X	X	X	X
X	X	—	—	X	X	0	0	0	0	0	X	—	X	—	—	•	X	X	X	0	X					
•	X	—	•	X	X	X	X	—	—	X	X	—	X	—	X	—	X	—	X	—	X	X	X	X	X	X

¹ Organic mercuries may be physically incompatible with some emulsifiable formulations.

Key to symbols

- X Materials can be used together.
- Materials cannot be used together.
- Materials are physically compatible and their combination does not increase their damage to plant tissue. However, they are incompatible in that the residual effectiveness of either or both would be reduced.
- 0 There is no need to use materials together, or they should not be used together because of increased toxicity to the operator

How to use this chart

This chart is made on the same principle as a mileage chart. For instance, if you want to know whether Bordeaux mixture and DN 111 should be used together, you read down the column headed by "Bordeaux mixture" until you get to the row labeled "DN 111." The minus sign where the two meet indicates that the materials are not compatible and should not be used together.

(Orchardists will find this kind of spray record very useful.)

RECORD OF MY APPLE SPRAY SCHEDULE 195....

SPRAY	Started (date)	Finished (date)	Total gals. or tanks	Materials used or other remarks
Dormant				
Prepink				
Pink				
Bloom				
Calyx				
Calyx top-off				
COVER				
First				
Second				
Third				
Fourth				
Fifth				
Sixth				
Sixth top-off				
SECOND BROOD				
First				
Second				
Third				
Fourth				

RECORD OF MY PEACH SPRAY OR DUST SCHEDULE 195__

SPRAY or DUST	Started (date)	Finished (date)	Wind direc- tion	Amount of material used	Materials used or other remarks
Dormant					
Prebloom					
Bloom					
Shuck-split					
COVER					
First					
Second					
Third					
Fourth					
Fifth					
Sixth					
Seventh					
Eighth					
Ninth					
Tenth					
Eleventh					

Weekly Report on Orchard Insects and Diseases

Radio programs. Each Monday noon the ILLINOIS FARM HOUR gives latest information on controlling orchard pests. This program originates at W-I-L-L, the University of Illinois Radio Station, 580 on your dial.

Many other stations give similar service. Consult your local station, your farm adviser, or the Illinois Agricultural Experiment Station, Urbana, for details.

Reports by mail. Mimeographed copies of *The Spray Service Report*, carrying the same information as the radio programs, will be sent to Illinois orchardists under free mailing privilege at no cost to them. Anyone wishing to receive these weekly releases by faster mail may send \$1.00 to the Illinois Agricultural Extension Service, Mumford Hall, Urbana, Illinois, to pay for first-class mailing. (Either stamps or checks payable to the University of Illinois are acceptable.)

Out-of-state growers will be furnished this information under postage at the above rates if the total number of requests is not too large.

These weekly reports are prepared by the agricultural experiment stations of Indiana, Kentucky, and Illinois, the Kentucky State Horticultural Society, the Federal Deciduous Fruit Insect Laboratory at Vincennes, Indiana, and the Illinois State Natural History Survey.

It is probable that the federal government will establish spray-residue tolerances for DDT, TDE, parathion, and chlor-dane, as well as all other poisonous agricultural chemicals, by harvest-time, 1953. If these materials are used in the concentrations and at the times suggested in this circular, there should not be excessive spray-residue on the fruit at harvest. **Do not use such materials within one month of harvest, for there is no evidence as yet that heavy residues can be removed by washing.**

AN EASY METHOD FOR

Germinating Flower Seeds

plus seed storage hints

CIRCULAR 796



UNIVERSITY OF ILLINOIS • COLLEGE OF AGRICULTURE
EXTENSION SERVICE IN AGRICULTURE AND HOME ECONOMICS

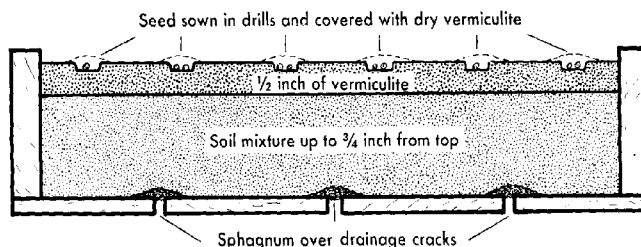
An Easy Method for Germinating Flower Seeds —Plus Seed-Storage Hints

By G. M. FOSLER, Instructor in Floriculture

HOME GARDENERS, as well as professional plantsmen, often have difficulty in successfully germinating seed indoors or in the greenhouse. Failure is frequently due to damping-off. But a poor seeding medium, improper temperatures, or sowing too deeply may also be responsible. The ideal seeding method should be easy to use, economical, and comparatively foolproof. One that measures up very well is described below. It has given consistently good results over a period of years with many different kinds of flower seeds.

A METHOD FOR GERMINATING SEEDS — 10 STEPS

This method utilizes both soil and vermiculite (heat-expanded mica). It takes advantage of the desirable properties of vermiculite for seed germination, while the soil supplies nutrients for the young seedlings. Vermiculite holds large quantities of water, yet retains perfect aeration. Furthermore it is very light and easy to handle, and is also sterile because it has been heat-treated. The soil-vermiculite seed flat is simple to set up, and attractive from the standpoint of cost, availability of materials, and quality of seedlings produced. For consistently good results, follow as closely as you can each of the 10 steps outlined on the following pages.



Cross-sectional diagram of a seed flat prepared according to the 10 steps that are outlined in this circular.



After lightly covering drainage cracks in container with sphagnum, add a soil mixture of loam, organic matter, and sand. (See Step 1.) Then level, and firm gently. (See Step 2.)



1. Fill the container up to $\frac{3}{4}$ inch from the top with a screened soil mixture of:

- 1 part garden loam
- 1 part leafmold or shredded peatmoss
- 2 parts sand

This light mixture drains well and makes it easy to remove seedlings with a minimum of root damage — yet usually provides sufficient nutrients.

Conventional seed flats (either wood, metal, or plastic), seed pans, or other containers can be used. Before filling, be sure to *lightly* cover the holes or cracks in the bottom with sphagnum moss to hold in the soil, but also to maintain adequate drainage. Arching pieces of broken pottery over drainage holes is also satisfactory.

2. Sterilize the soil and container if at all possible. At the same time, sterilize any tools or other implements that will come into contact with the soil or vermiculite during the seeding operation.* By all odds, steaming is the most satisfactory method. It kills damping-off fungi and other disease organisms, as well as weed seeds, insects, and nematodes. Ideally, the soil should be moderately moist and held at 180° F. for 30 minutes. (Caution: plastic pots or flats may soften or disintegrate at this temperature.)

Where facilities for steam sterilizing are lacking, commercial formalin (37-40 percent formaldehyde in water solution) may be the answer. It is not as thorough, however, as steam or other forms of heat. Formalin can be purchased inexpensively at any drugstore. Use 2½ to 3 tablespoons to each bushel of soil; or 1 tablespoon to a 20" × 14" × 3" flat of soil. Dilute the specified quantity of formalin with 4 times that amount of water, and mix thoroughly with the soil before putting it into the flat. The soil should be moist, about as for potting. Also keep it loose — don't tamp or pack it.

Place the treated flat of soil under a tight cover, such as a piece of canvas or plastic sheeting, for at least 24 hours so the formaldehyde fumes will have time to act. Formaldehyde sterilization is best done when the air is fairly warm and the temperature of the soil to be treated is at least 65°-75° F. Remember — the fumes are toxic, so keep them away from plants and animals. Be sure *all* fumes have left the soil before you do any seeding.

3. Level and gently firm the soil, then moisten it by sprinkling or by setting the flat in a sink or deep pan of water. When the soil is completely saturated, remove the flat and let all excess water drain away.

4. Pour vermiculite onto the soil to a depth of ½ inch and level carefully. For extremely small seeds, such as those of African violets, begonias, and gloxinias, use only ¼ inch of vermiculite (see Step 6). Use the horticultural grade of vermiculite (about ⅛ inch in diameter). Do not pack. Vermiculite is quite free of disease organisms in the original package — try to avoid contaminating it. With a fine sprinkler, gently wet the vermiculite layer. Using a ½-inch strip of wood, make slight depressions ⅛ to ¼ inch deep in the moist vermic-

* For more complete information on this subject, see Circular 793, "Soil Sterilization Methods for the Indoor Gardener."



Pour enough vermiculite onto the soil to make a $\frac{1}{2}$ -inch layer, level, and sprinkle gently; then make shallow "drills" about 2 inches apart. (See Step 4.)

ulite. These depressions, which should be about 2 inches apart, are the rows or "drills" into which the seed is sown.

(It is sometimes recommended that the container be filled entirely with vermiculite, using no soil. If this is done, however, it will be necessary to apply a liquid fertilizer at frequent intervals once the seed has germinated. Vermiculite contains no nutrients and the seedlings soon become stunted and starved.)

5. Treat the seed with a protective fungicide, such as *thiram 75*, *captan 75*, or *chloranil*. These are common names for the materials, not trade names. Therefore, look for them under "active ingredients" on package labels. For each ordinary seed packet, use an amount equivalent to one-half a match head. Add slightly more to large packets. But don't overdo it — too much fungicide can be harmful. Balloon the envelope and shake vigorously for about 30 seconds so each seed gets a light dusting with the fungicide. Seed treatment is one very important precaution against seed rot and damping-off.

Some firms supply seeds which are already treated, and this is usually indicated on the packets. Do not treat a second time. A fungicide is often included in the coating material of pelleted seeds.



Treat seeds with a protective fungicide, using an amount equal to about half a match head. Too much can be harmful. (See Step 5.)



Sow seed thinly and evenly in rows. (See Step 6.)

6. Sow the seed thinly and uniformly along the depressions. Tap the envelope with your forefinger to get the seeds to roll out at a uniform rate as you move the envelope along the row. Row-seeding is usually preferable to broadcasting because it permits better air circulation and makes it easier to remove the seedlings later.

If you are planting extremely small seeds, sift finely shredded dry sphagnum moss or peatmoss in the depressions, moisten, and then sow the seed directly onto this material. Do not cover these seeds, but it may be well to place a piece of glass over the flat to retain moisture. As germination occurs, gradually lift the glass to give the seedlings more air.

7. Cover the seed with a light layer of dry vermiculite (except as mentioned in Step 6), the depth depending on the size of the seed. As a general rule, cover to a depth equal to about 3 times the diameter of the seed. With rather small seeds such as petunia, portulaca, and flowering tobacco, apply only a scattering of vermiculite particles among the seeds. Sprinkle lightly to finish off the flat.

8. Place flat in a draft-free room or greenhouse, preferably in a semi-shaded location. No glass covering will be needed ordinarily.

Most flower seeds germinate excellently in the temperature range of 65°-75° F. However, temperatures 10-15 degrees cooler than this are recommended for delphinium and larkspur seed. Seeds of a few varieties germinate more rapidly at somewhat warmer temperatures (about 5-10 degrees higher than the 65°-75° range); for example, asparagus, bells of Ireland, coleus, and zinnia.

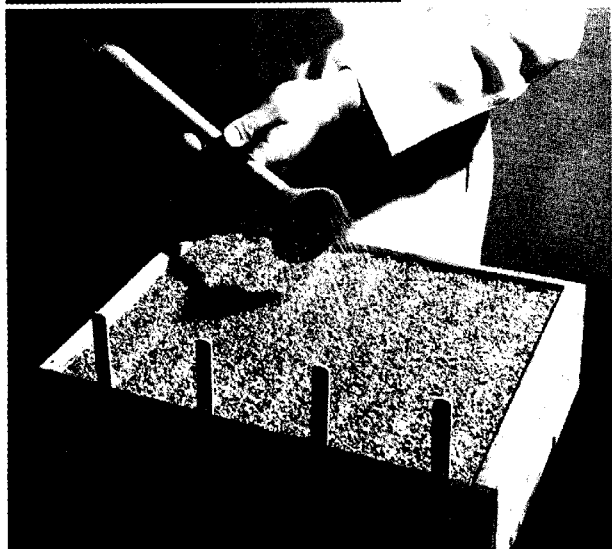
9. Water only as necessary. Remember that vermiculite holds a considerable amount of water, yet drains well. To be on the safe side, check moisture twice a day. Sub-irrigation is good, especially for very small seeds, but a fine rose on the sprinkling can or hose is fastest and simplest. Apply water gently.

10. Move the flat to a cooler location (55° to 60° F.) when germination is complete. It usually takes the seedlings only a few days to emerge. Choose a spot that is well ventilated and in full sunlight.

Ordinarily no fertilizing is needed. For the very fine seeds, you may need to make several applications of a complete liquid fertilizer before the roots have penetrated down into the soil. One or two ap-



Cover seed with a thin layer of dry vermiculite, then sprinkle lightly. (See Step 7.)



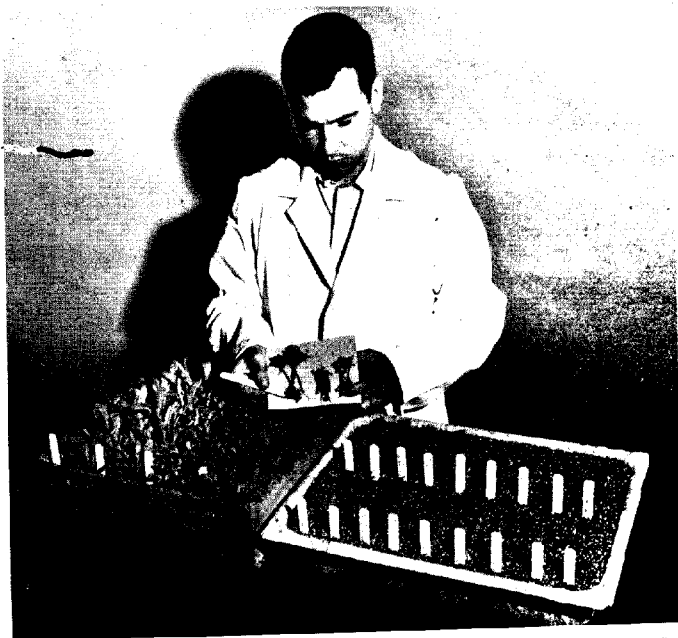
• plications a week should be sufficient. Watch seedling development for indications of whether fertilizing is needed.

If damping-off should occur in spite of your best efforts, try to arrest it promptly. Several of the newer fungicides are helpful. Among them are *Pano-Drench 4* or *Natriphene*. Dilute them according to • directions and drench the affected flat, using a sprinkling can.

Other good fungicides for this purpose include *captan*, *ferbam*, *thiram*, and *ziram*. Any one of these materials can be dusted lightly on the vermiculite surface and seedlings, but a liquid application is more effective. Follow package directions for mixing and applying.

Transplant the seedlings as soon as they are big enough to handle easily. Never let them become overgrown before pricking off into pots, flats, or bands.

Later seedlings can be made in the same container by simply scraping off the top layer of vermiculite, loosening up the soil, resterilizing, applying new vermiculite, and seeding as described above.



Transplant seedlings before they are overgrown like those in the wooden flat and the left-hand group of seedlings on the card. The other two groups on the card came from the metal flat. They are much smaller and will transplant with very little set-back. (See Step 10.)

**Approximate Number of Days Required for Complete Germination,
Using Method and Temperatures Recommended in This Circular**

Plant	Days	Plant	Days
Ageratum.....	4-7	Nicotiana.....	7-10
Aster.....	6-10	Nierembergia.....	8-10
Bachelor's button.....	4-6	Pansy.....	8-10
Calendula.....	5-7	Petunia.....	8-12
Calliopsis.....	7-9	Phlox drummondi.....	7-10
Celosia.....	4-8	Portulaca.....	5-7
Chinese forget-me-not.....	11-13	Rudbeckia.....	7-9
Chrysanthemum, annual.....	6-8	Salvia.....	9-12
Colcus.....	8-10	Scabiosa.....	7-9
Cosmos.....	4-7	Snapdragon.....	9-12
Dahlia.....	5-7	Spiderflower.....	9-12
Dianthus, annual.....	5-8	Stocks.....	5-7
Gaillardia, annual.....	7-10	Summer cypress.....	7-9
Globe amaranth.....	6-10	Sweet alyssum.....	3-6
Lobelia.....	8-10	Tithonia.....	5-6
Marigold.....	4-7	Verbena.....	11-16
Marvel of Peru.....	5-9	Vinca rosea.....	9-13
Nasturtium.....	7-12	Zinnia.....	4-7

HINTS FOR STORING SEEDS

It is usually wise to buy fresh flower seeds each season. Yet almost every gardener will have a few packets left from spring planting that he doesn't want to throw away. Or perhaps he has gathered seed of several varieties himself from the garden for later use. (Note: Seldom is it worth while to save flower seeds from your own plants, *unless* you are certain the various types you gather will "come true." Most do not.) Many kinds of flower seeds remain viable for several years — if stored under proper conditions. Merely putting them into a drawer or tucking them away in a cupboard may result in disappointingly poor germination the following spring.

Storing garden seeds under the right conditions can greatly increase their longevity. *They should be kept in a dry place and at low temperatures.* Reliable seedsmen have long found this to be good practice; consequently seeds bought from them almost always germinate well. If they don't, call the firm's attention to this fact. First be certain, however, that you've given them a fair chance by using a good seeding method, such as the one described in this circular.

How and where to store seed. A gallon-sized glass pickle jar with an air-tight cap makes a satisfactory container. Before storing seeds, let them thoroughly air-dry for several weeks. Do this when the

relative humidity is low and the air temperatures are fairly warm. Then put the packets into the jar and tighten the lid to keep out air and moisture. Keep the sealed jar where the temperature will be in the approximate range of 35° to 50° F. — such as in a refrigerator, basement fruit-storage room, or cave.

- Sow seeds as soon as possible after taking them from the jar; return the unused portions promptly. Also close the lid tightly after removing packets, and be sure to put the jar back in its cool location immediately.

Test seed for germination. Before planting time, it's always a good practice to test the various kinds of seeds you have stored to determine how well they will germinate. Do this by placing a counted number of each, such as 25 or 50, between two sheets of blotting paper or strips of soft muslin. Keep moist and hold at a temperature of 65°-75° F. To prevent them from drying out too rapidly, put seeds in a petri dish, a covered baking dish, or a pie tin covered with polyethylene plastic.

Remove and count the seeds as they sprout. Make your final count at the end of several weeks when all have had ample time to germinate, and compute the percentage of germination. Even if the varieties you test don't germinate too well, you may still be safe in planting them if you sow somewhat more thickly than usual. Remember, however, that weakly sprouting seeds have little chance of surviving when planted in soil. If germination is quite poor, by all means discard the seed and buy fresh.

Flower seeds that are relatively short-lived. Seeds of a few of our best-known flowers stay viable for only a year or so. Instead of storing these seeds, it is perhaps best to buy new seed each year to be certain of a good stand. They include:

Annual phlox	Larkspur
Basket asparagus (<i>A. sprengeri</i>)	Love-in-a-mist
China aster	Pansy
Columbine	Periwinkle (<i>Vinca</i>)
Cornflower, sweet sultan, etc.	Scarlet sage (<i>Salvia</i>)
(<i>Centaurea</i> sp.)	Spiderflower (<i>Cleome</i>)
Delphinium	Summer cypress (<i>Kochia</i>)
Fern asparagus (<i>A. plumosus</i>)	Torenia
Flax (<i>Linum</i>)	Verbena
Honesty (<i>Lunaria</i>)	Viola

The reward for your efforts . . .

**BEAUTIFUL HOME PLANTINGS
AT VERY LITTLE COST**



McFarland

Urbana, Illinois

June, 1958

Cooperative Extension Work in Agriculture and Home Economics: University of Illinois, College of Agriculture,
and the United States Department of Agriculture cooperating. L. B. HOWARD, Director.
Acts approved by Congress May 8 and June 30, 1914.

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